

How to build DIORAMAS

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BY SHEPERD PAINÉ

YOUR COMPLETE HOW-
TO-DO-IT GUIDE TO
DIORAMA PLANNING,
CONSTRUCTION, AND
DETAILING FOR ALL
TYPES OF MODELS



THIS BOOK is for you, whether you model aircraft, armor, automobiles, dollhouses, historical figures, ships, or something else, and regardless of the scales you model in. It's for you because it's a book that deals with diorama construction in depth, with emphasis on how you can learn the author's expert tricks of the trade.

Here, for the first time anywhere, a master modeler has taken the time to explain, step-by-step, how he designs, plans, and builds his dioramas from the ground up. Included are comprehensive discussions of weathering techniques, converting and painting figures, structures, details, shadow box construction and lighting, and even a chapter on photographing your finished dioramas. Finally, if you're the kind of modeler who learns better by doing than listening, or if you'd rather be shown than told, there are four step-by-step projects that vividly illustrate Shep's techniques—projects that you can duplicate as a means of learning those techniques yourself.

If you've ever had the urge to give a model the special display treatment that only a diorama can provide, if you want to add drama—or perhaps humor—to your modeling, you'll find the fully detailed, easy-to-follow instructions you need here in the pages of **HOW TO BUILD DIORAMAS**.



SHEPERD PAINÉ is one of the best-known modelers in the United States, if not the world. Although much of his fame comes from the stunning dioramas he created for Monogram Models to promote their armor and aircraft kits, his reputation is also based on his military miniatures and boxed dioramas, which have won prestigious awards throughout the United States, Canada, and Europe.

In 1972, Shep was elected the first Grand Master of the Miniature Figure Collectors of America. He is a member and Fellow of the Company of Military Historians. In addition to regular coverage in modeling magazines, photos of his work have been featured in such national publications as *Fortune* and *Sports Illustrated*. Shep is one of the few modelers fortunate enough to be able to devote full time to his craft. His output is small and his boxed dioramas and original figures are eagerly sought by collectors.

Shep has always had a desire to share his ideas and techniques, and he has successfully taught "how to" classes in modelbuilding; many of his students have developed significant reputations of their own. He is a graduate of the University of Chicago, and his other interests include a growing collection of military antiques and a long-suffering devotion to the misfortunes of the Chicago Cubs and Bears. This is his first book.

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BY SHEPERD PAINÉ

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China gunboat diorama on back cover by Cy Broman, all other scenes by the author

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A good model standing on its own is certainly interesting, but a diorama provides an historical setting and a feeling of drama that might otherwise be difficult for a viewer to visualize.



1 Introduction

A diorama, in the strictest sense of the term, is a scene enclosed in a box and viewed through a small opening, something we more commonly call a "shadow box." In recent years, diorama has come to mean any scene executed in three dimensions, whether it is enclosed in a box or not. At its most basic, then, a diorama is nothing more than a model or group of models placed in a realistic setting. This setting almost invariably involves a landscaped base of some sort, and probably a few figures to add scale and interest.

Once installed in a setting, however, any model undergoes a transforma-

tion. It becomes part of a three-dimensional picture, an image as vivid and informative as a painting or a photograph. This is because a model standing alone is limited to being just what it appears to be: a miniature replica of an object in real life. In a diorama setting the model is placed in context, and the context furnishes a frame of reference which amplifies and further illustrates the model's meaning and significance.

Here's an example. A model of a Sherman tank standing alone shows what the tank looked like, but gives little indication of the role the Sher-

man played in WWII. But add a diorama setting that shows the tank rumbling down a dusty Normandy road, with battered fenders hanging loose and bone-weary crewmen slumped in the hatches, and your viewer will appreciate the rugged durability that made the Sherman a part of American history.

A scene that tells a story. The diorama provides a meaning and perspective that a free-standing model cannot. It can also offer more than just an historical context. In its most developed form, a diorama is a scene that tells a story. This does not imply a story in the narrative sense, it simply means that a diorama can show "something going on." In this sense, a diorama is not just a model of an object or a group of objects, but of an *event*. This event may be active and obvious, such as an infantry attack, or it may be passive and subtle, such as weary infantrymen resting after a battle, or a forlorn and derelict aircraft abandoned

in the desert. When a diorama becomes narrative, figures become an important element; it is difficult to have something going on without people around. Even when there are no people at all, as in the case of the derelict airplane, it is their conspicuous absence that tells the story and makes the scene work.

The size of a diorama is not important; in fact, some of the most effective dioramas are quite small. Small dioramas, often called vignettes, gain visual strength from their compactness; because the story is compressed into a small area with a minimum of distractions, the viewer can absorb it immediately.

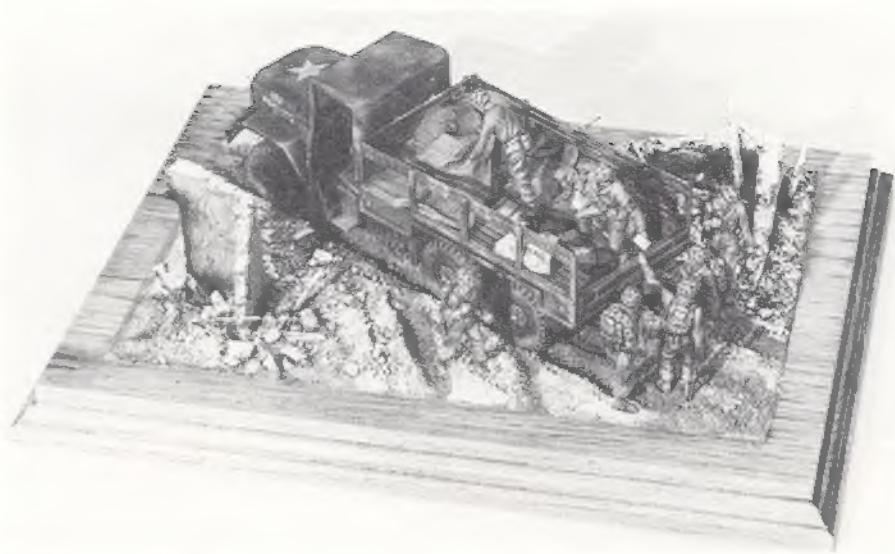
Although dioramas have long been an accepted form of display for museums, their popularity as a hobby is a relatively recent development. Museums have featured dioramas of all sizes and descriptions for many years. A diorama of the 1796 Battle of Lodi was commissioned by Napoleon himself shortly after the campaign and is still on display today in the *Musée de l'Armée* in Paris. The many dioramas in the Science Museum in London and the Smithsonian in Washington are world famous. Natural history museums make frequent use of full-size dioramas to display animals in their natural habitat. Museum displays are well worth seeing and can give you ideas for your model work.

The fellow who builds dioramas in his basement or on his kitchen table is of necessity working on a much smaller scale than a museum. He must tailor his efforts to his much more limited display space once the work is completed. But even within these restrictions the hobby is quite a recent development.

As a hobby, diorama building has grown out of other model-making hobbies—model aircraft, armored vehicles, ships, and figures—while remaining a distinct branch of each. In a sense, diorama building really does not exist as a hobby in its own right, but only as part of these other hobbies. Aircraft modelers build aircraft dioramas, armor enthusiasts build armor dioramas, ship modelers build ship dioramas, and figure painters build figure dioramas, with little or no crossover between them. None of the four groups seems to have much awareness of what the other three are doing.

This book is for all modelers who wish to use dioramas to display their work. Regardless of the type of models the techniques involved are very much the same, and I hope that the modeler working in one area will bear with me and tolerate specific attention given to the other three.

Your approach to dioramas will vary, depending upon your modeling experience and area of primary inter-



The most interesting dioramas are those that tell a story, such as this scene of Marines at mail call. Quiet vignettes are often more effective than shoot-'em-up action.



This spectacular life-size Indian buffalo hunt diorama is a featured attraction at the Milwaukee Public Museum in Milwaukee, Wisconsin.

est. If you're an aircraft or armor modeler, you'll want to focus attention on the machines you are modeling, and you'll want to use the dioramas to set them off. If you're a figure modeler, you'll probably want to tell a story. Your approach to dioramas will depend not only on your own attitude toward your hobby, but also may vary from one project to another. A favorite aircraft or vehicle may qualify for a simplified treatment that focuses attention on the centerpiece, while other models become minor players in story dioramas.

For armor and aircraft enthusiasts, dioramas offer a chance to place a subject in an historical context or to illustrate an aspect of the real thing that is not easily discerned from the model itself, such as a hand-started prop on an aircraft. To the figure painter, tired of doing individual figures on individual bases, there is the opportunity to put several of them together in a related grouping.

The skills you'll need. The diorama builder must not only master the skills of his particular area of interest, but must also learn landscaping, weather-



This ambulance vignette by French modeler Pierre Conrad shows that dioramas needn't feature tanks, airplanes, or modern subjects.



Imaginative—sometimes offbeat—ideas, such as these GI's who have taken up farming during a lull in the fighting, can be fun. Little humorous touches like the rooster perched on the machine gun and the fellow milking the cow into his helmet are very important to the success of such lighthearted scenes.

ing, figure painting, simple scratch-building, and working with new materials. If he ventures into shadow-box dioramas, he must learn some basic electricity, too. This broad area of new skills often scares away would-be diorama modelers. With no previous experience, the first diorama seems to present a formidable obstacle indeed.

This need not be the case. A few basic techniques, which can be mastered in an evening or two, are all that you really need to get started. From there you'll be building on your foundation

techniques by adding a few new tricks to your repertoire with each new project. You'll be surprised at how rapidly your abilities expand this way, and in six months you may well find yourself doing things that you never dreamed of being able to do when you started.

No techniques in this book are beyond the ability of an average modeler, but this is not a book for outright beginners. It describes how to place models you have already built into a setting, not how to build the

models themselves. If you are just starting out in plastic modeling, you would probably be better off to start out with **BUILDING PLASTIC MODELS**. Once you have mastered the basic techniques and have a few models under your belt, you'll be ready to try your hand at dioramas.

If you've never built a diorama before, relax. This book is for you. The dioramas described in the four step-by-step chapters are introduced in the order of their difficulty. You can start with a simple scene, and as you gain experience and confidence in your ability, you can proceed to more complex projects. Just putting a finished model on a landscaped base is a good start, and more important, it's the first step along the road to more ambitious projects. You'll be pleasantly surprised how quickly your skills develop once you start working.

It is important to point out that there is no single way to do things. Modeling is always a very personal endeavor, and methods that work well for one person may not work at all for another. I know capable modelers who have trouble getting results the way I do things, while some of their methods are equally baffling to me. For this reason I will try to give alternate techniques whenever possible. If one way seems to be giving you trouble, try the other. Any method that works for you is the right one.

You don't need to be an artist to build fine dioramas. Although some viewers consider dioramas an art form, few people who build them have any formal art training. If you can assemble and paint a plastic kit, you can build a diorama—you needn't be a sculptor, illustrator, or designer. People trained in these areas may have a momentary advantage in some aspects, but they also have a lot to unlearn. Basically, building a diorama is a process of taking existing elements from plastic kits and elsewhere and combining them into a scene. A diorama is only as complicated as you care to make it. All that is required is basic modeling skill, a bit of self-confidence, and some imagination.

Imagination, more than any other ingredient, is the key to building successful dioramas. Imagination comes into play in many areas—choosing a subject, layout and planning, and selecting and using materials. You have much more imagination than you give yourself credit for, but it may never have been exercised. If you make an effort to seek innovative solutions to problems as they arise, you will find that your ingenuity and imagination grow with experience.



A diorama can simply show off a model, as at left (model by D.C. Ryan), or it can tell a story, as at right.

2

Ideas and planning

Of all the steps in building a diorama, planning is most important and most frequently overlooked. Most dioramas that miss the mark usually do so because of critical planning errors before construction is even begun. Designing a diorama is not difficult, but it's always worthwhile to make sure that the basic concept of your diorama is well thought out and that the way you intend to carry it through is practical and sound. Planning is the foundation on which your diorama is to be built, and whatever time you devote to ensuring the strength of that foundation is time well spent.

Ideas. All dioramas begin with an idea. How do you find an idea? A good way to start is to ask yourself just what you want to do with your model. First, what *kind* of idea are you looking for? Is this a favorite subject that you want to show off on a simple landscaped base, with as few distractions as possible? Does it have any unusual features that ought to be shown off? Or do you want to show an event or do a story? Sort out which of these goals you want to achieve in the beginning, because they will affect your thinking throughout construction. While it is possible to achieve several goals in a single diorama, one goal must dominate the others, and you will have to be careful not to allow the supporting ideas to usurp its importance.

Keep your primary goal in mind as you work, even after construction begins. When obstacles arise to interfere with your original idea, don't hesitate to make adjustments to compensate for them. You may find that

figures have to be rearranged, added, or subtracted, vehicles repositioned, or buildings enlarged or reduced. If you keep your basic goal in mind as you work, you can make such adjustments comfortably as you go along.

Having decided what kind of idea you want, there are more questions to answer. What are the characteristics of a good idea? How can you tell if your idea is practical? How do you develop it into a diorama?

The simplest diorama is a base that is used to display a particular model. Developing this idea consists of deciding what sort of groundwork you want and how many additional details to include. A single figure is always a good addition. It will not compete with the model for attention and provides a readily understood measure of scale. Moreover, because a viewer's eye will eventually be attracted to the figure, you can position it in such a way as to draw attention to a feature of the model that you want to be noticed. A

figure standing near the drive wheels of a tractor, for example, will serve to emphasize how massive they are. Positioning a figure next to the odd-shaped tail of an aircraft can help ensure that viewers notice this peculiarity.

You can take this a little further by having one or more of the figures engaged in action that shows off some characteristic of the model that might otherwise be missed. For a fighter armed with an unusually large cannon, you might add ground crewmen loading ammunition. For a German armored vehicle with overlapping road wheels, a scene of crewmen trying to change an inner wheel could graphically demonstrate the disadvantage of that design.

When searching for ideas, try to come up with something that shows your subject "doing its thing," performing a task it was designed to do, or otherwise engaged in characteristic action. For armor, this means nothing more than showing scout vehicles scouting and assault vehicles assaulting. This approach is roughly analogous to museum dioramas that show animals in their natural habitat.

The natural habitat of an airplane is the sky, and any diorama you do of a plane on the ground will show it out of its element. Unfortunately, airborne aircraft dioramas are grossly impractical and very difficult to build. The only things that airplanes do on the ground are get serviced or crash, so the "doing its thing" idea doesn't have much application to aircraft.

If you want to do a story diorama, the search for an idea becomes more involved. Most often, inspiration comes



Your subject will often have special features that you want to show, such as the folding wings on this carrier aircraft.



Show your subject doing its thing. The German sturmpanzer Brummbaer was designed for street fighting, so this setting is particularly appropriate.

from things we have seen or read in books, so the best place to start is your own reference library. The local public library is also a good source. Local libraries often have unpublished histories of local combat divisions with many unusual pictures.

Avoid trying to copy a photo exactly. Doing so will only hamper your search for an idea, and can severely reduce your flexibility once you start construction. Instead, try to take ideas and details from photographs and combine them into a scene of your own.

Evaluating your idea. Once you have an idea you think might work, evaluate its effectiveness as a diorama. The first thing to bear in mind is that you are working for an audience. Whether you are aware of it or not, you are trying to put your idea across to a viewer. What effect will the idea have on the viewer? Can the idea be put across visually? Certain ideas fail to work in a diorama

setting because they are too difficult for the viewer to comprehend just by looking at them. A fighter pilot testing his engine, for example, is difficult to carry off successfully because the action of the pilot is lost in the cockpit. Even if you can get the prop to spin, there is no motion that is characteristic of a pilot testing his engine as opposed to preparing for takeoff or shutting down after landing. However, if the figure in the cockpit is clad as a ground crewman, and another figure is operating a piece of support equipment, the idea, slightly modified, can be put across.

Most ideas have to be carefully thought out to make the action obvious. Consider a scene of a tank crewman trying to clear a jammed .50 caliber machine gun. Basically a good idea for a story diorama, it could lack narrative strength if not handled properly. Just placing the man's hand on the cocking lever is not enough to

carry the idea across—after all, he could just be cocking it. But if you emphasize the jam by opening the feed cover and making the figure really strain to pull back the cocking lever, the idea begins to click. Placing the tank at an awkward angle in a ditch with a dead crewman slumped over in one of the hatches dramatically sharpens the urgency of the situation and all of a sudden you've got yourself a dynamic idea!

Artistic license. Occasionally, you have to take a few liberties with the facts to put your point across. Call it artistic license. The degree to which you are prepared to do this is very much a matter of personal taste, but even the most straitlaced modeler has moments when he is sorely tempted! I generally don't mind stretching the truth if doing so explains the scene more clearly. In the diorama of the B-24 assembly ship the garish color scheme is an essential part of the aircraft, but it is doubtful that the crew would have started painting the polka dots until they had finished spraying the overall white. I felt it was important to show both operations, so I fudged a little. The spray painting operation without the polka dots would have been dull and uncharacteristic of the assembly ship, while showing only the detail painting would have meant eliminating the technical interest of the spraying equipment.

Bear in mind the sophistication and knowledgeability of your prospective audience. If you are building just for yourself and other modelers, you can delve into some pretty esoteric stuff, but if your diorama will be loaned to a local library or displayed in your family room where people unfamiliar with your subject will see it, you are better off to keep things simple.

Your idea may have to rely on a caption to put its idea across, although the most effective dioramas, like the funniest cartoons, are those with no caption at all. The tank with the jammed machine gun mentioned above would not be hurt by the simple title "Jammed!", but it really doesn't need it, either. Some ideas may require explanation in the form of a small card placed next to the exhibit. Such a card should, however, be supplementary; if everyone has to read the card to understand what is taking place, the idea itself is probably weak.

Next, there should always be one center of attention, with the rest of the action supporting it. This is true whether the central focus is an object, such as a vehicle or aircraft, or an event. Too often, modelers go overboard in adding little "scenes within the scene" until the overall impression becomes one of total confusion. A maintenance scene, for example, is always a good subject as long as the



The TBD-1 Devastator was a notoriously unsuccessful aircraft, usually meeting the fate shown here, so in a sense the plane is in its natural habitat in this diorama.



Scenes like these are natural diorama ideas. Above, "I thought the lines were THAT way!" Below, "Mail call."



various activities of the mechanics support the main action. Even a subplot, such as a crap game in a corner, is acceptable as long as it remains in the background. If there are too many subplots, the main action is lost and confusion sets in. Always select a single major focus of attention with no more than one or two subplots, put it near the center of the diorama, and subordinate everything else to it.

Is your idea practical from a standpoint of size? Many ideas develop size problems when you start working with them. In a photograph or painting you have the option of "cropping down" to your subject, but in a diorama this option is severely limited. Two pilots in conversation next to the nose of their B-24 makes a nice photograph because you see only enough of the big bomber to recognize it for what it is. If you tried a diorama of the same scene, similarly cropping off all but the nose of the B-24, the effect would be ludicrous. The section of airplane would look just like what it is—a section of an airplane. You can usually crop off sections of buildings, fences, and similar features and maintain the impression that they continue beyond the edge of the diorama, but you can't crop vehicles or aircraft. All you can do is select a smaller vehicle, or reduce the conversation to a subplot. If your diorama idea depends upon a large vehicle as a *supporting* factor, you can anticipate trouble with size.

Space problems will also arise be-

cause, except in shadow boxes, you don't have the luxury of perspective. At first glance, a fighter plane up on blocks to zero its guns seems to be a good idea for a compact diorama. But if the idea is going to work, you have to show the target the plane is firing at, and that would be 50 yards away. Even in 1/72 scale that comes to 24" of open, empty space between the plane and the target, and your compact diorama has suddenly grown out of control! Similarly, a scene showing a single partisan cutting telegraph wires seems simple until you realize that supporting the wires requires

another pole the proper distance away on either side. The net impression changes to a long section of telegraph poles with the partisan thrown in as an afterthought. One solution might be to scatter additional partisans around the base of the pole to restore balance. Another might be to crop the scene back to one pole by using stiff wire that could be cut off a short distance to either side of the pole. This might turn out to look like a television antenna, so you'd better experiment before going ahead with it.

Large airplanes create a problem of a different sort. A model with a length of

EMPHASIZING THE STORY LINE



Make sure that your story line is forcefully carried over to your viewer. In A, it is not clear that the machine gun is jammed (the soldier could just be cocking it). In B, the open cover and straining figure make the jam more evident. In C, the location of the vehicle and the dead crewman add urgency and drama, and the jammed gun becomes central and obvious.



All of the painting operations on this assembly ship probably would not have been done at the same time, but the painting idea comes across much more strongly if the operations are shown that way.



A busy aircraft scene requires a lot of activity to fill the space around the model. I posed Monogram's B-26 on a factory assembly line to provide justification for plenty of detail.

19" and a wingspan of 24" will cover very little of the large base it requires, leaving vast open areas in front and in back of the wings. If you want to create a busy impression such as a maintenance scene, you'll need a lot of figures and equipment to fill the empty space. Sixteen figures may overwhelm a P-51 Mustang, but they don't have much effect at all on a B-29.

Humorous Ideas. Do you want to be funny? Humorous ideas are among the most difficult to carry out; they require thoughtful planning if they are to work. There are three kinds of humorous dioramas: the major gag, where the humor is the central theme; the minor gag which plays a supporting role, either to a major gag or in an otherwise-serious scene; and the delayed-reaction gag, which depends upon the viewer not seeing the humor immediately.

A major gag diorama is a cartoon in three dimensions, but there is an important difference. A cartoonist, working on paper, can eliminate distractions and simplify details to focus attention on his joke—as a diorama builder, you can't do either. Major gags are difficult to carry off successfully. If

you're doing a major gag, make sure that it dominates the scene—the joke must be the first thing the viewer sees. Keep your scene as small and simple as possible, because jokes which are funny as quickly drawn cartoons are out of place done in oils on a large canvas. Finally, if a joke is your major attraction, it had better be funny. Nothing looks more foolish than a joke that has gone flat!

Minor gags, on the other hand, are not overly difficult and can add a lot of fun to your dioramas. These are whimsical "little touches"—a rooster perched on a gun barrel (page 4), fanciful nose art on a bomber, or an uninjured GI examining a bullet hole in his helmet. Be careful that these touches are neither so subtle that nobody notices them, nor so strong that they overshadow the main idea. Ensure, too, that the main diorama idea is compatible with humor; funny touches are out of place if the main theme is very serious.

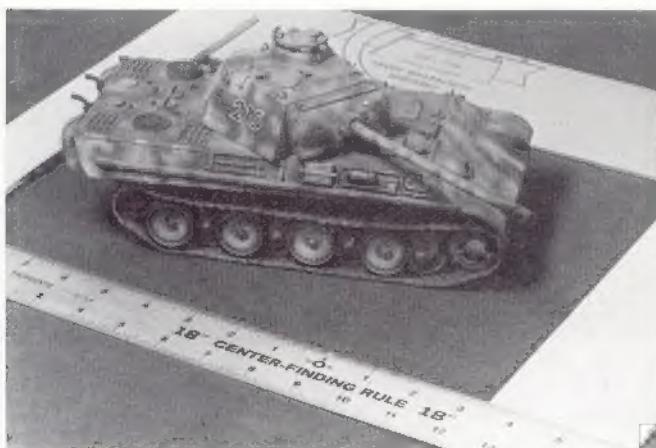
The delayed-reaction gag is the most difficult humorous diorama to pull off. This is a joke that the viewer does not catch immediately, but that hits him suddenly as he looks closer. To work

successfully, this kind of idea requires what comedians call timing. The joke must be arranged in such a way that you have some control over how long it takes the viewer to spot it. What you must do is hide the joke, then give the viewer clues to find it. The more clues, the quicker he finds it, the fewer clues, the longer it takes. You can never predict viewer reaction with much accuracy; all you can really hope for is that the viewer will not spot the joke immediately, and that he will see it before he loses interest and walks away.

The only way to test humorous ideas is to show a mock-up to several friends to see if it elicits the correct reaction. If it doesn't, discuss the idea with your test viewers to determine how it can be improved, then test it again on someone else.

If your idea meets all of these criteria, it will make a good diorama. But it is still only an idea—and probably a rather vague one at that. The next step before construction is to develop the idea in detail and test it in a three-dimensional format.

Layout and composition. Layout and composition involve recognizing



The preliminary layout for a simple diorama is done by using the model, a ruler, and a few cardboard strips to establish the rough borders around the main subject.



Small humorous touches are easy to add. Note the patch of yellow snow at the base of the trees.



A good illustration of a diorama with no element parallel to the edge of the base. The aircraft, concrete panels, and runway markings all run at different angles. Model by Dave Smith.

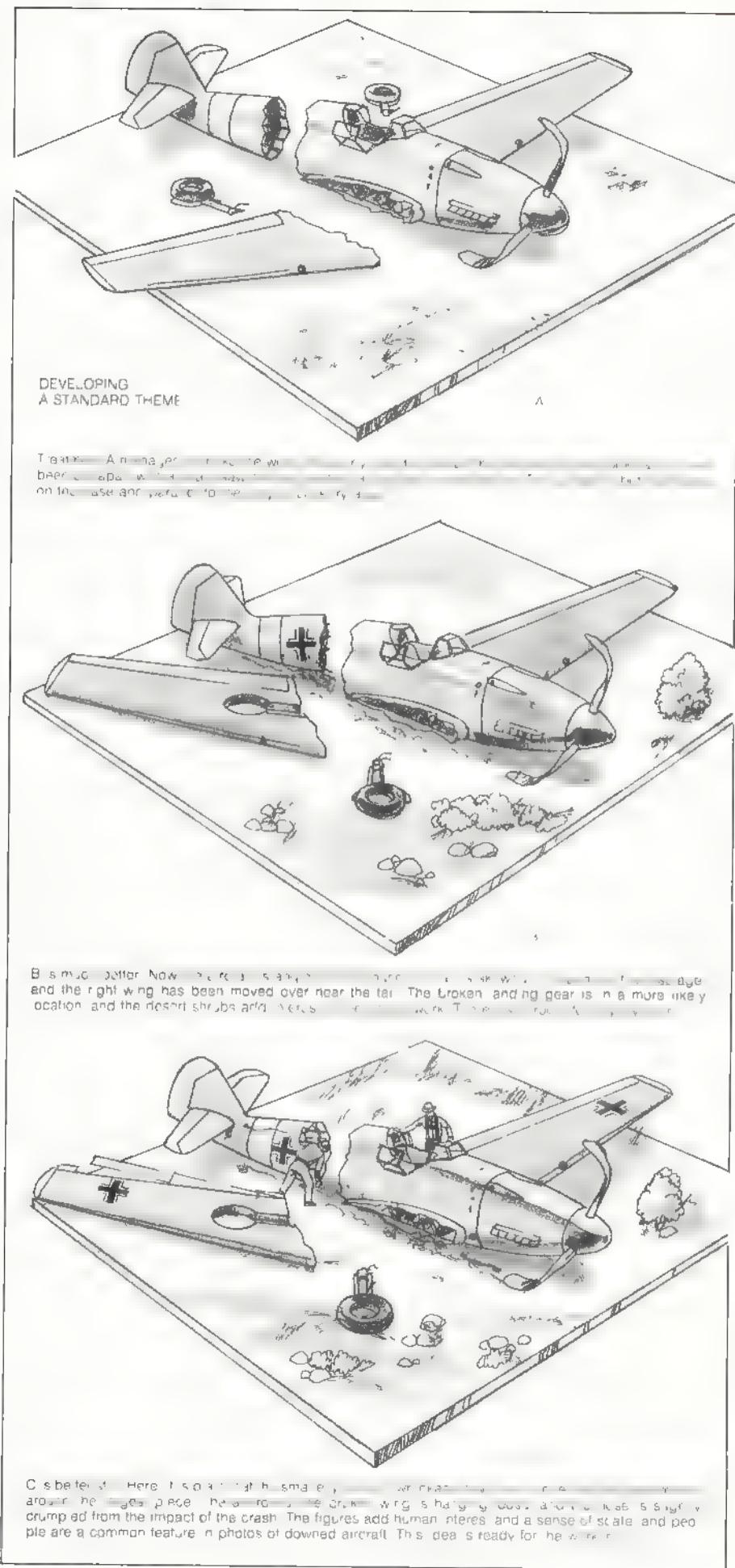
the important features of the subject and arranging the elements of the diorama in a way that sets them off. They are the process by which we translate our abstract idea into physical reality. *Composition* is determining the overall design of the diorama, while *layout* is arranging various parts to fit that design. In practice, all this means nothing more than shuffling the pieces around until things look right. There are, however, a few ground rules and tricks of the trade that simplify these steps. Let's start with composition.

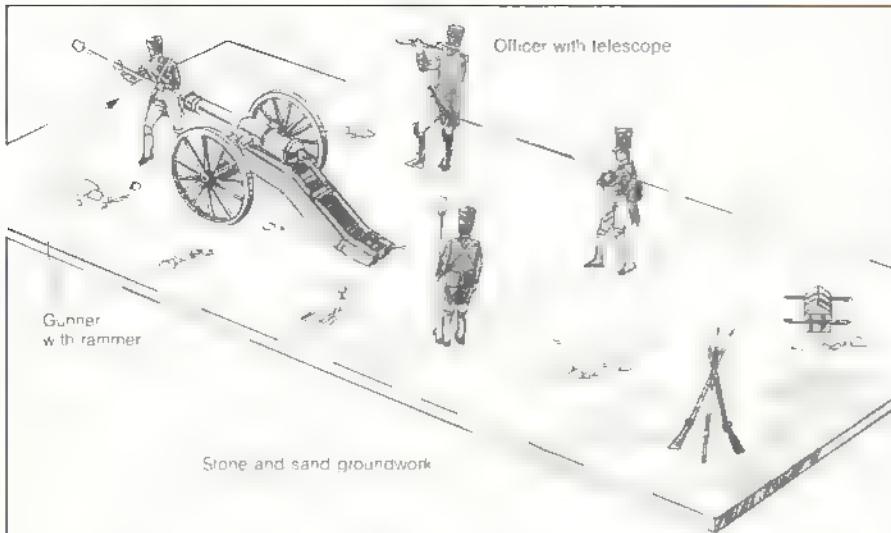
The purpose of composition is to arrange the elements of the diorama so that they direct the viewer's eye smoothly from one part of the design to the next, ensuring that he sees everything and sees the important things first. A good way to begin thinking about how to accomplish this is to analyze how an average viewer looks at your diorama. Generally speaking, viewing is a three-stage process. First, as the viewer walks over to look at your piece, he will glance quickly over the whole scene. If your diorama is properly designed, this glance should be enough to tell him what is going on. He will also see the general arrangement of the larger parts (buildings, vehicles, etc.), but will not have time to notice individual figures or details.

In the second stage, the viewer's eye travels systematically across your diorama, absorbing smaller items missed on the first pass. This second pass will not be very systematic because of the numerous distractions that will catch the viewer's attention. It is probable that his eye will move from left to right, because we are all conditioned that way by reading. An interesting effect caused by this conditioning is that when a column of troops or vehicle is moving from right to left, against the grain, the eye is more likely to pause and notice small details than if the objects were headed in the other direction. This also means that, other things being equal, the right side of the diorama (where the eye stops) is visually stronger than the left.

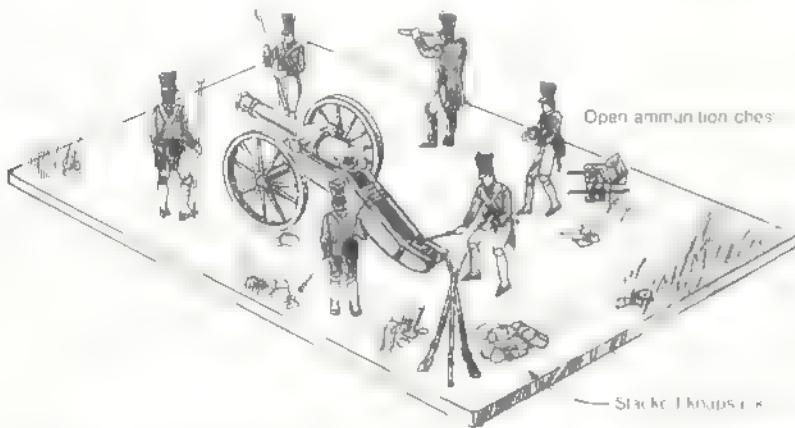
In the third stage, having had a chance to get his bearings and see what there is to see, the viewer will return to details that caught his attention to examine them further. Awareness of how this viewing process works will be helpful as you develop and arrange the parts of your dioramas.

Designing a simple diorama. Laying out a simple diorama such as an airplane on the tarmac or a vehicle on plain ground is an excellent way to illustrate composition and layout. Since we have only one piece—the airplane or vehicle—there is a distinct limit on the variety of arrangements open to us. All we have to do is figure out how big the base is going to be and

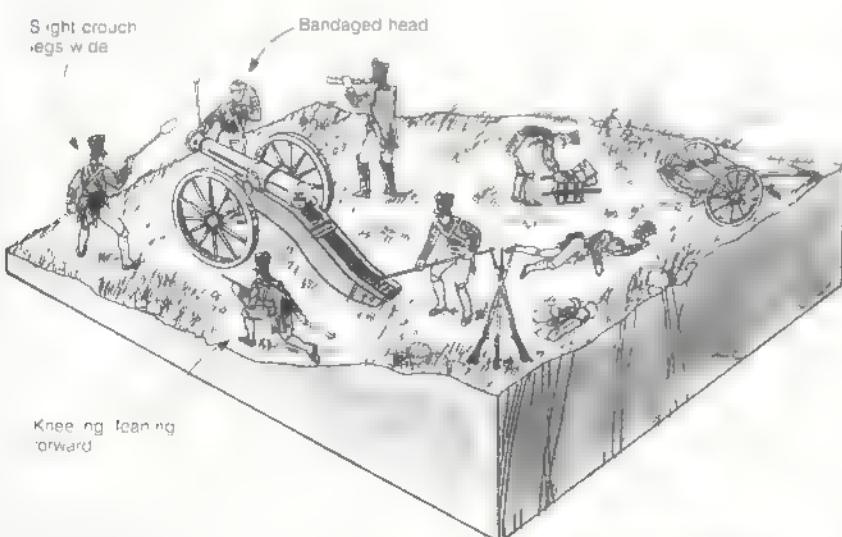




This fairly standard diorama needs a lot of improvement. The base is far too large for the cannon pointing directly off the end. There are too many figures across the base in an unsuccessful attempt to cover the base.



BETTER
Here the cannon is angled on a smaller base, and more figures have been added to stiffen the diorama. The lid of the ammunition chest is open to show what it is, and a pile of gear is added near the stacked muskets. The right corner is still rather bare.



BETTER STAGE
The addition of a gunner has helped solve the space problem and made the scene more dramatic. A bandaged head and a kneeling figure help stage the whole scene on a slope, providing a sense of direction. The scene has drama and direction, and the diorama will be more interesting.

BASIC IDEA DEVELOPMENT

at what angle the model will be placed on it. Always make the base to fit the model; never allow the size of an available base to make this decision for you. Bases are easy to make, and nothing looks more awkward than a model on a base that is either too large or too small.

Set your model on a flat surface. Place it at an angle that you like and use books, rulers, or anything handy to establish a border around it. Give the model some breathing room, but don't overwhelm it with space. For vehicles, 1" or 2" of space all around is about right; for airplanes, wingtip to wingtip is fine, but never allow the wings to extend beyond the edges of the base.

In positioning your model on the base you will want to observe an important rule: *Never put anything parallel to the edge of the base*. You want to maintain an illusion of snapshot spontaneity to give the impression the groundwork extends beyond the confines of your base. If any element in your diorama is parallel to the edge, it convinces the viewer that the scene was constructed to fit the confines of the base, rather than the base made to fit around the scene. This may seem unimportant, but it is vital. It is also easy to do—remembering it is the trick.

Arrange your airplane so that it is at an angle, and unless you are showing a moment just prior to takeoff, angle the seam lines in the concrete a different way. With aircraft it also helps to move the model an inch or so back off center, leaving more room in front of the nose than behind the tail. This provides the impression that the airplane is more likely to go forward than backward. Armored vehicles can run at all sorts of odd angles; even if you show a tank moving down a road, the road should not parallel the edges of the base. Even a slight angle, as little as 5 degrees, is enough to do the trick.

Once you have the model angled the way you like it and have established a perimeter for the base, measure the size of the base with a ruler and you are ready to start work.

Planning a story diorama. Laying out a diorama with more pieces requires considerably more thought. Here, even if we don't have a story to tell, we have certain aspects of the scene that we want to attract more attention than others. We want to control and guide the viewer's perception, and in some cases, we want the viewer to notice things in a particular order. The crap game in the maintenance scene mentioned earlier is a good example: we want to ensure that the subplot is noticed, but not so quickly that it interferes with the main event. Arranging plots and subplots may sound a bit like trying to impose order on a cat fight, but it is not as



Building sizes can be deceptive. The structures in this diorama are scarcely two stories high, yet they appear much taller.

hopeless as it seems. While we can never predict viewer reaction with 100 percent certainty, we can arrange things so that they work most of the time.

We discovered that there is a pattern in the way most viewers look at things. Now let's look at the ways we can make that knowledge work for us. The best way to develop a design is to start laying out the pieces. You can make some rough sketches if you want to, but don't waste time working a sketch out in great detail, because what looks good on paper has a way of falling apart in three dimensions. Start working with the actual models as soon as possible. If the models are already built or in progress, you can use them to establish rough positions and base size. Even if construction has not begun, you can lightly tack the major parts together to provide a representation of sizes and shapes. If the wheels or landing gear are not yet installed, use blocks, paint bottles, or anything handy to raise the model to the proper height. Mock-ups of buildings or other major props can be made up quickly from cardboard and later used as patterns.

If your idea includes figures, be sure to include them in your planning, and if you are going to do any pose converting, this is the stage at which you'll want to start working on it. Tack the figures together with modeling clay to establish basic positioning. Take your time with the figures, because in many ways, they are the most important element in your diorama. Don't bother adding equipment or other details, but get the posing just the way you want it.

Don't be afraid to experiment with all sorts of things at this stage. Rearrange the figures and vehicles to see what develops. One idea leads to another, and you may stumble onto a better design than the one you originally had in mind, many of the best dioramas develop that way. You may come across ideas that look terrific, but don't really fit into your current

project. Don't force them in where they don't belong; file them away for use in a future project.

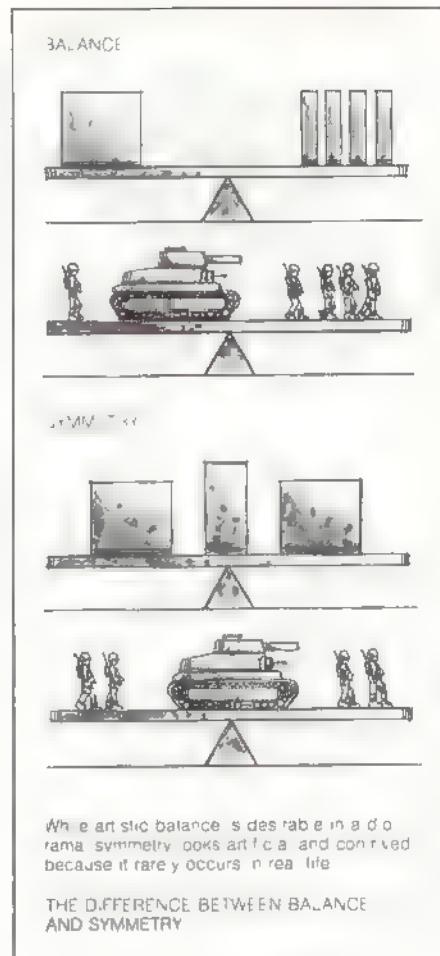
Your first concern when laying out your pieces for a story diorama is to think your idea through, item by item. Make sure every figure and accessory fits comfortably without conflicting with the central theme. There should be a logical reason for everything in the diorama being where it is and doing what it is doing. Why is that figure bending over? Who is that soldier shooting at? Why is this man shouting? To whom? Why would someone put those oil drums there? Is that really the best place to stand while repairing that engine? Why are those weapons stacked over there? Is that mechanic holding the proper tools for what he is supposed to be doing? By asking yourself these questions and others like them, you can tie off many of the loose ends of your diorama before you begin work. Your design will be "tighter" and more logical, and your viewer will readily understand your idea.

Another major consideration is the relative size of the elements in your diorama. If your main event is relatively small, take care that background buildings, vehicles, and subplots do not overpower it. The viewer should not only see your main event first, he should see it immediately. If you find background items are too large, cut them down. If a vehicle is too big, replace it with a smaller one. Bear in mind that the cumulative weight of a lot of little items can be as overpowering as one or two big ones. If there is too much going on, don't be afraid to weed some of it out. Even if your diorama shows as much action as a three-ring circus, the act in the center ring should still be the main attraction. If lesser acts will detract from the main event, save them for another project.

Once your viewer has located and identified the main event (phase one of the viewing process) you must guide his eye around the rest of the diorama



Here, the figures provide dramatic urgency, emphasize the purpose of the vehicle, and imply an enemy that is not modeled.



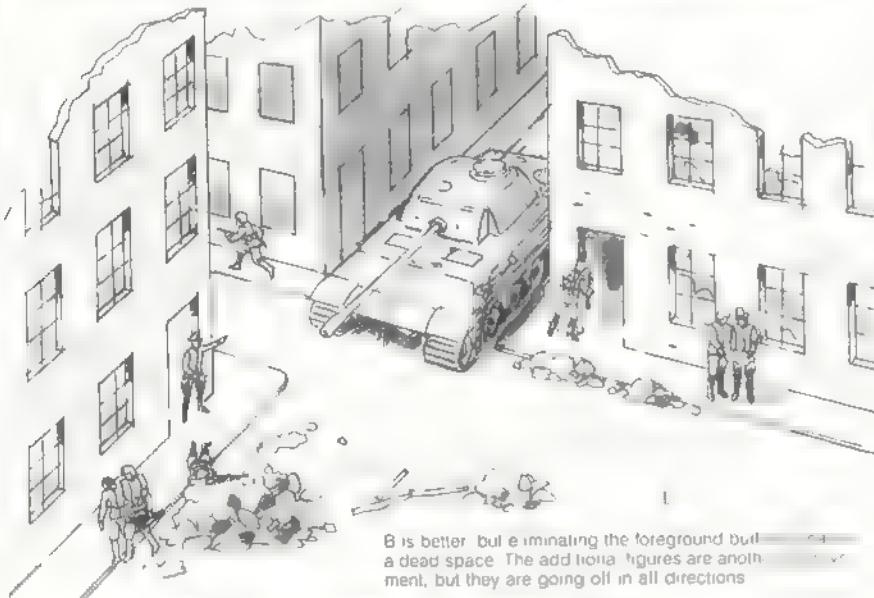
(phase two). You don't want him to miss anything. The left-to-right viewing sequence is one thing to bear in mind, but there are other ways of guiding the viewer that are even more effective.

Placing and posing figures. Figures are your strongest allies. Pay close attention to where your figures are looking, pointing, or moving. Viewers will instinctively glance in the same directions, and you can use this to great effect. If you arrange the figures in your scene properly, you can direct a viewer's eye from one point to the



In this urban combat scene A, no one figure is large enough to dominate the scene, and there are not enough figures to show what is going on, and

nothing is happening in the center of the diorama. The buildings are too large and the action is too small.



B is better, but eliminating the foreground buildings creates a dead space. The additional figures are another improvement, but they are going off in all directions.



C is better still. Pointing the gun at the viewer, the infantrymen are all shooting and moving in the same direction, and the overall scene has less dead space.

enemy and the dead jeep effectively

next—figure A is shouting to figure B, who is standing next to C, who is looking in the direction of D, and so forth. You can also use this effect to direct attention back toward the center of your diorama. By having your figures look back into the center of the scene you can ensure that your viewer does not wander off the edge. This is not to say that all figures at the edge of your diorama should be looking back toward the center, but if they are looking off the edge, there should be a perceptible reason for it. Without such a reason, your viewer will instinctively try to find one and be confused when he doesn't. For example, one figure looking off the edge is a riddle, while a man shouting and beckoning to someone outside the diorama makes more sense.

If you show troops in combat, don't have them shooting or attacking in several directions at once unless they are clearly supposed to be surrounded. Troops attacking in the same general direction provides a dramatic sense of motion and leaves no doubt as to where the off-base enemy is. Watch out for figures standing alone, isolated from the main action. A figure standing alone becomes a one-man subplot, and must have a valid reason for being where he is. A way to link a solitary figure to the main action is to have someone nearer the center talking or shouting to him. Be sure to keep the two figures close enough that the viewer can see the connection; 4" is about the limit. Often, crewmen on top of a large vehicle or aircraft appear isolated from the main action. This can be corrected by having one figure lean over and talk to someone on the ground, and the connection can be strengthened further if the talking figure points to something (on or off the diorama) and the other figures look in the same direction.

You can also use background details and clutter to channel your viewer's attention. The eye has a natural tendency to travel along long, slender objects. A fallen log, for example, can be used not only to fill up empty space, but also to guide a viewer around a corner and back into the diorama. The log can point to something you want to be seen, or serve as a connector between two objects separated by open ground. You can make this ruse a little less flagrant by pointing the log slightly away from the target so that it serves as a tactful suggestion instead of a direct order. The eye also is drawn toward the tallest and highest objects in a scene, so if an important element of your diorama is getting lost, move it to higher ground.

Balance. Another consideration in laying out your diorama is one that is not likely to affect the telling of your story, but that will have a lot to do with its visual appeal. This is *balance*.



A good example of off-center balance in a diorama. The fence and antitank weapon balance the tank, while still creating an interesting and natural scene. Diorama by Dave Smith.

What balance means in a nutshell is this: every diorama has a right side, a left side, and a center, and there should be something to engage the viewer's attention in each part. If you look upon your diorama as a teeter-totter, the weight of visual attractions on one side should be about equal to the weight on the other. If you have a big event on one side, you need a couple of smaller events on the other side to balance it. The same applies to shapes: if you have a large vehicle or building on one side, you need a number of smaller objects on the other. Open space is also a factor in balance. A small object standing conspicuously alone can have as much visual weight as a larger object with less space around it; a single figure can often balance a large vehicle. The ingenious and subtle ways objects can be balanced against each other is something that cannot be learned overnight. Experimentation and observation are your best teachers.

It is important to understand that balance does not mean *symmetry*. In fact, you should go out of your way to avoid symmetry except where it occurs in real life. This is closely related to the "nothing-parallel-to-the-edge-of-the-base" rule. Few things in real life are laid out with a T-square and calipers, so you'll have little use for right angles and exact measurements in your dioramas. Don't be afraid to try

unusual angles, shapes, or designs, even with your bases. There is no law that states bases have to be round, rectangular, or square. Trapezoids, ovals, and kidney shapes work well, and provide novel and unusual touches. Don't hesitate to experiment with different ground levels in your dioramas. Often, all a conventional idea needs to make it spectacular is one or two elements shifted up to a higher level. There is a wide variety of landscaping excuses for doing this

Another visual consideration when laying out your diorama is what to do with "dead space"—open ground with nothing on it. You don't want to leave it empty, but don't overfill it, either. Put in just enough to keep your viewer's eye moving smoothly over the scene from one detail to the next. It doesn't take much to fill dead space; leaves on the ground or oil spots on the runway are often enough. Other convenient devices are small shrubs, runway cracks, branches and twigs, discarded equipment, and irregularities in the ground. Small animals can also be useful. If you can find them, snakes and lizards are good for desert scenes and are relatively easy to make with epoxy putty.

When laying out these minor details, be careful that their arrangement does not appear arranged. Make sure your discarded equipment and fallen



It usually doesn't take much effort to fill empty areas. Here, empty ammunition canisters and rough ground vegetation have both been used effectively.

branches are strewn about in a random, careless manner. Avoid even spacing and parallel alignments. This is harder than it sounds; it requires a conscious effort to be random. I have seen excellent battlefield scenes that looked artificial because the battlefield debris was as carefully selected and laid out as the stones and flowers in a Japanese rock garden. The arrangement, though seemingly random, was just too perfect to be natural.

Finalizing your design. Don't hesitate to spend a week just fiddling around with the pieces, rearranging them to ensure the design you finally settle on is something you'll like. Many of the ideas we've discussed here may well be things you have been doing all along without being aware of them. If you are just starting out, you can use this chapter as a checklist, but as you gain experience, let your instinct and your eye be the ultimate judge. Then, if something doesn't look quite right, the principles discussed here may help you correct it.

Above all, be patient. No matter how long it takes, you must have your idea thoroughly worked out before moving on to construction. When the base size, building design and dimensions, vehicle location, and figure poses and positioning are all firmly established in your mind, you are ready to start building.

From the ground up

Many modelers who devote inordinate amounts of time to their model grudgingly spend only an hour or so working on the base and groundwork of the diorama on which it will be displayed. Neither of these two elements requires a great deal of time or skill. All that is necessary is an awareness of their importance and a few basic techniques. The base forms the frame for your diorama "picture," and just as you would not put a Rembrandt in a dime-store frame, neither should you put your model on a hunk of scrap lumber.

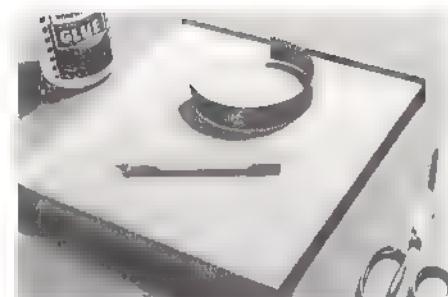
Types of bases. Once you have determined its dimensions, decide what kind of base you will use. Some are more elaborate than others, but none requires a woodworking shop to build. The easiest bases to construct are of plywood or particle board. Use a piece $\frac{3}{8}$ " to 1" thick; thinner material may warp. It pays to buy good plywood, because cheap grades have

knotholes and other imperfections which can spoil the edges of your diorama. If you don't have the facilities to cut the wood yourself, you can usually have the lumberyard cut it to your specifications for a nominal fee. You shouldn't have to buy an entire 4' x 8' sheet; most lumberyards sell scraps.

Once the base is cut, use sandpaper wrapped around a block of wood to sand the edges. The sanding needn't be perfect because you are going to cover the edges, so just smooth down the rough spots. Walnut veneer can be purchased in 1"- or 2"-wide rolls at your lumberyard or hardware store. Standard length for a roll is 6', enough for one base. To apply the veneer, cut a strip the length of one of the sides, leaving an extra $\frac{1}{8}$ " at each end. Brush an even coat of white glue onto that edge of the base. The veneer manufacturers suggest contact cement, but I have found that this leaves too little time for adjustment. Lay the veneer in place, aligning it with either the top or bottom edge but allowing it to overlap on the other three. Press out air bubbles with a block of wood and set aside to dry. Later, trim the excess veneer off roughly with a scissors or craft knife and use your sanding block to sand the edges of the veneer flush with the base. Repeat this process for the other three sides.

Your base is now ready to varnish. Any clear finish is fine, but I prefer clear lacquer in an aerosol can because it dries fast and is easy to apply. Proper finishing will require about three coats. With open-grained woods such as walnut, sand lightly between coats with fine sandpaper to help fill the grain.

There are several variations of the plywood and veneer base. The first involves applying veneer to the top edges as well as the sides. Veneer the edges in the usual manner, then cut a strip of veneer slightly longer than one side, hold in place, and trim to exactly the right length. Cut each end to a 45 degree angle with scissors. Glue this piece down, aligning it carefully with the edge. Lay the next piece in place and use the angle cut in the previous piece to draw the matching angle. Cut, test the fit, cut the other end to 45



The simplest do-it-yourself diorama base is nothing more than a slab of plywood with walnut veneer applied to the edges.

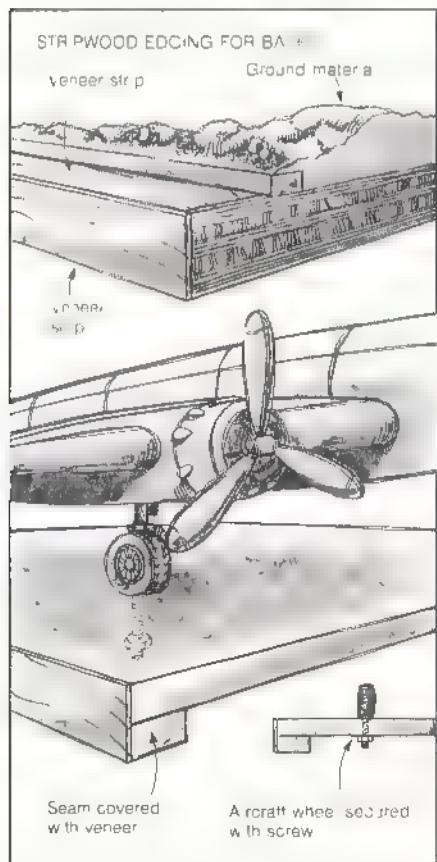


Groundwork materials, left to right: Cellu-clay, Wilhold aliphatic resin woodworking glue, Boyd Static Grass, coarse and fine sand, and pebbles.

degrees, and glue. Repeat the process for the third and fourth sides. You will have to match angles at both ends of the fourth piece, but if you take your time it is not hard.

Another variation is a small containing ridge on the base for your landscaping. Use the small strips of basswood available at most hobby shops— $\frac{1}{8}$ " square is about right. Cut the strips to length, then cut the ends at an angle greater than 45 degrees. Since the landscaping will cover all but the vertical edges of the strips, there is no point in attempting a perfect mitered corner, and an angle of more than 45 degrees will ensure a neat joint where the strips meet. Stain the basswood to match the veneer and glue it in place.

You may find it useful to incorporate a similar ridge at the bottom of your base. This creates a hollow space under the base which is useful if you use nuts to attach your model to the base or when wiring must be run underneath.





This more elaborate base has additional veneer strips applied to its top edge, as well as a small stripwood ridge to contain the groundwork.

The size of the ridge will depend upon how deep a recess you require. Install the ridge before any veneer is applied. Cut the corners to more than 45 degrees to ensure sharp corners, and allow the strips to slightly overlap the edge of the plywood. Sand them flush after the glue has dried, then veneer over both plywood and ridge at the same time in the usual manner.

Yet another type of base is the picture frame, nothing more than a piece of thin plywood set into an ordinary picture frame. This type of base requires a frame with a raised center. Ready-made frames come in many standard sizes suitable for diorama bases. Don't try to save money by making your own frame at home; frame assembly requires precision cutting that calls for precision machinery. Custom-made frames are expensive, but there are shops that specialize in do-it-yourself framing. They cut the wood to your specifications, and you nail it together in their shop using their clamps and materials (they'll even show you how). This is an inexpensive way of making an attractive base. Fill the center of the frame by tacking in a piece of plywood.

Glass or plastic display covers must be custom-fitted to the base, so you must decide whether you want a cover early in the game. A cover will keep your diorama dust and damage free, but it can be expensive, even if you build it yourself. Consult the Yellow Pages of your phone book for a supplier of acrylic plastic. Most plastic manufacturers provide booklets with step-by-step instructions on how to cut and assemble their product.

Earth and rocks. The first step in ground texturing is to prepare the base. If you have any significant terrain features, such as roads or trenches, mark their locations. Give the base a quick coat of varnish to seal it against moisture from the ground-making material.

Although there are many materials that will produce satisfactory terrain, my favorite is a commercial paper-mache called Celluclay. It mixes with water, is relatively clean to use, usually dries overnight, and has a nice, earthlike texture. It can be mixed with powdered color to pre-color it, but I don't often bother with this.

Prepare your Celluclay by piling a small amount of the dry material in the bottom of a mixing bowl. You will eventually develop a feel for how much material a given job will require, but in the beginning it is better to mix up too little and have to make more than to mix up too much and have a lot left over. Mix in water a little at a time. A drop or two of dishwashing detergent or window cleaner will serve as a wetting agent, overcoming the natural resistance of the dry material to the water. Knead the Celluclay with your fingers until it is thoroughly mixed, adding water until the mixture has the solid, gooey consistency of bad oatmeal. Draw off excess moisture with a paper towel. If the Celluclay is thin and runny, it will shrink when it dries, showing the outline of blocks or figure bases underneath it.

The final ingredient in the Celluclay recipe is a generous dollop of white glue to help the mixture adhere to the base. If you don't add white glue, the Celluclay tends to curl up at the edges. The amount of white glue is not critical, but it is better to have too much than not enough. A tablespoonful is about right for a blob of Celluclay the size of a scoop of ice cream.

The easiest and most efficient way to mix Celluclay, either natural color or tinted, is in a food processor. Toss in the required ingredients, throw the switch, and a few seconds later you will have a smooth working paste. Clean the machine thoroughly with water when you are done or your next milk shake may taste of groundwork!

When the mixture is at its gooey

Smaller boulders embedded in the ground and revealed by erosion



LOOK LIKE THIS



ROCKS AND BUDDER



Because they include a variety of grain sizes, natural gravel and sand from outdoors (right) are much better suited for diorama groundwork than commercial earth or model railroad ballast (left).

best, transfer it to your base and use your fingers or a rubber spatula to spread it to the edges, leaving slight rises and hollows in the ground. Smooth the material neatly down at the perimeter with your finger. Excess Celluclay can easily be wiped off the edges of the base while still wet, but you may want to cover the veneer with masking tape while installing and painting the ground, particularly on a large project. At this time you should install buildings, figures with bases, and any accessories that must be embedded in the ground. Work the Celluclay up to and around them with a small screwdriver or similar tool.

The next step is ground texture. Stay away from the sand, gravel, and earth sold in hobby shops, because these materials are far too uniform to be realistic. Unless you are modeling a crushed-gravel driveway, what you need is a natural assortment of sizes and textures. The best place to find this assortment is the gutter in front of your house. Mother Nature has conveniently deposited there a bonanza of sand, pebbles, and tiny rocks that are perfectly suited to dioramas.

Install the rocks first. Set them into the ground, not on top of it. Pay some attention to the topography of the area where your scene is set. Rocks vary in size, shape, and number from one part of the country to the next. If you are modeling farm country, stone walls or irregular piles of rocks should be



Note the colors of the sand and the scrubby desert vegetation in this WWII North Africa scene



placed around the edges of the fields. After the rocks are positioned, sift the sand into place using a coarse sieve and tamp lightly into the surface with your fingers. Leave the Celluclay bare to simulate packed earth.

Grass and low vegetation. Unless you are modeling a desert scene, rocks and sand alone will look too desolate. There are several commercial products available to simulate grass, including dyed sawdust and shredded foam rubber. While the foam products are adequate for smaller scales such as HO and 1/72, in larger scales they look like

just what they are—foam. The best product I have found is Boyd Models "Static Grass," a form of fiber flocking manufactured in Germany for model railroads. Static Grass consists of millions of little individual blades of grass, from $1/16$ " to $1/8$ " long.

To apply Static Grass, brush white glue onto the areas you want to cover, then sprinkle on a generous amount. Gently blow off the excess; this action will also make the remaining fibers stand upright.

Dyed sawdust and shredded foam, while inferior in appearance to Static Grass, do occasionally have their uses. They are applied in the same manner as Static Grass. Sawdust, an old standby used by model railroaders, is effective in the larger scales. Be sure to buy brown sawdust sold as "earth" rather than the garish, phosphorescent green "grass." You are going to paint the stuff anyway, but if you should miss a spot, the brown will not be as obvious as the bright green.

Additional low vegetation such as bushes, crabgrass, and weeds can be made from a number of materials. This is one application where shredded foam works well in all scales. Another possibility is to use the genuine article, some kind of natural growth. Check with your florist to see what he has. Asparagus fern, air fern, and other

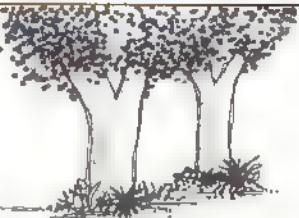


Dave Smith used mat board for the runway under his A-10. Note the subtle surface texture, the cracks, and the runway markings. The Tactical Air Command crest is a decorative touch.

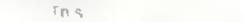
VEGETATION PATTERNS

Trees are usually surrounded by undergrowth, unless this is cleared away by man

Ground vegetation usually grows in irregularly sized and spaced clusters



Tall grass also grows in irregular clusters and clumps, not even patterns



TREES ON SLOPES



This runway surface is sanded plywood. Note the oil stains and the tufts of grass growing up in the concrete expansion seams.

decorative growths make good vegetation and foliage.

When all of the ground cover and texture is in place but while the Celluclay is still wet, carefully position your vehicles and figures and press them firmly into place. You want your models to appear to have weight and to sit firmly on the ground. Nothing looks quite as foolish as a 60-ton tank delicately perched on a row of pebbles, with daylight visible under its tracks. On wheeled vehicles, cut or sand a flat onto the bottom of each tire to provide the illusion of weight. While it is sometimes a good idea to leave vehicles and figures in place until the ground work is dry to ensure a proper fit when they are replaced after the ground is painted, be sure that you will be able to remove them before painting.

When the Celluclay has dried completely (usually overnight, but during periods of high humidity it may take longer), you are ready to paint it. Always paint your ground texture unless you are using foam, which doesn't take paint very well. Bare groundwork and texture may look pretty good, but painting will always improve their appearance and also helps when you come to blend the vehicle with the terrain. Use oil or lacquer-base paints because these will not soften the Celluclay.



desert terrain mix a lighter dusty tan. After you have applied the earth color, while it is still wet, mix up a dark green and apply it to the grassy areas. Don't worry if the green and brown blend together a bit where they meet; this is desirable.

Highlighting ground texture. When the first coat of color has dried, preferably overnight, you are ready to highlight the ground texture. Highlighting is accomplished by a technique called "dry-brushing." Dry-brushing is an important technique to master because it is used in many phases of diorama modeling, particularly weathering. Highlighting ground texture is its simplest application, and an excellent way to learn.

The best brush for dry-brushing ground texture is a 1"-wide white bristle artist's oil-painting brush. You will use finer red sable brushes for dry-brushing models, but a coarse brush is better suited to rough ground. Mix a color distinctly lighter than the base coat you applied previously, and dip only the tip of the brush into it. Stroke the brush back and forth a few times on a scrap of cardboard to remove most of the paint, then whisk it lightly across the surface of the ground, just touching the raised surfaces. There should be just enough paint on the brush to deposit color on the raised surfaces; no color should run into the recesses. It may take several passes of the brush to deposit sufficient paint, and in some cases you may even use a scrubbing motion.

Now mix a still lighter shade of the same color and repeat the process, brushing so lightly that you hit only the high spots. Repeat with an even lighter color if necessary. The net effect of this dry-brushing will be light color on the higher surfaces and darker shades in lower areas. This gives your ground a realistic three-dimensional quality. There is no rule that says your highlight color must be derived from your base color, but it's usually easier



When the Celluclay and Static Grass are dry, paint the grassy areas overall dark green, then dry-brush them with a slightly lighter shade of green.

that way. To lighten earth colors you generally add white, but be sure you work toward a tan color rather than gray. If you find the color changing to gray, add tan. If necessary, start over with a fresh batch of color.

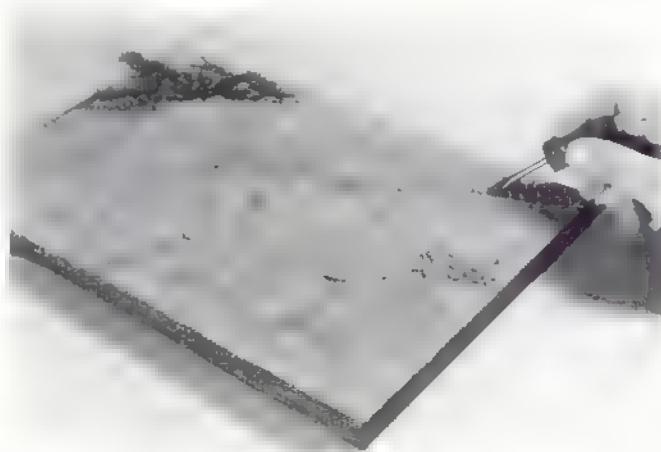
Dry-brush grassy areas just as you did the earth, using yellowish green instead of tan. You want a lot of contrast, so don't hesitate to use almost straight yellow. Dry-brush a little of your earth color into the fringes of the grassy areas so your greens and browns fade into each other, leaving no sharp edge. This provides a subtle, natural effect.

Runways. Aircraft diorama builders face special problems in modeling runways and hardstands. One solution is to use Celluclay and roll it out flat with a rolling pin—use flour to keep the Celluclay from sticking to the roller. Sprinkle the surface with uniform fine sand (N scale model railroad ballast is ideal), let dry, and paint. This method makes excellent asphalt runways, which usually aren't perfectly flat. To simulate concrete, apply the fine sand directly to the plywood base. Brush on white glue, sprinkle on sand, and blow off the excess. An alternate method is to use cardboard. Pebble-textured mat board works well; just cut

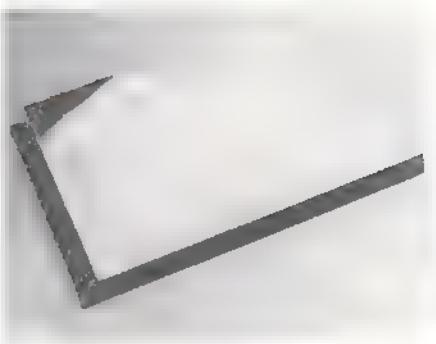
Use an ordinary house painting brush $\frac{1}{2}$ " or $\frac{3}{4}$ " wide. If you have one, there is no reason why you can't use an airbrush for this initial painting. Begin by brushing a liberal coat of thinner over the entire surface. This breaks the surface tension and ensures that the paint will run into all the little nooks and crannies in the ground cover. Mix up a dark brown about the color of polished walnut, keeping the color slightly on the greenish side. Avoid reddish browns unless red clay is a particularly notable feature of the area in which your scene is set (such as Georgia or the central highlands of Vietnam), because the unusual color will attract undue attention. For



After the Celluclay and Static Grass were applied to the base of this armor diorama, I used the model to press in tread marks. I



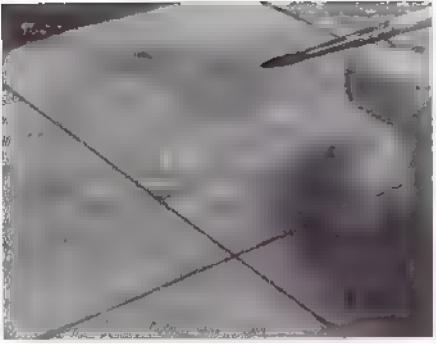
deepened the marks with a small screwdriver to simulate turf torn up and broken by the action of the tracks.



This runway base has been edged with veneer, brushed with white glue, and sprinkled with fine model railroad sand. A strip of grass was added to one corner to provide a little interest. Next, the runway surface was painted Floquill Concrete, and



tarred seams added using a hypodermic syringe and black artist's acrylic tube paint. Finally, the runway surface was weathered using several shades of brown and black, heavily thinned. Tapping the brush creates a spatter effect.



it to size and glue it over plywood. Both sand and mat board surfaces are painted and dry-brushed in the usual manner. Remember that concrete is more often tan than gray, particularly when it gets older.

Concrete runways are made of panels with expansion gaps left between them. These gaps are usually filled with tar which permits expansion but seals out water. The tar seams have a distinct three-dimensional quality that simply painting them on fails to reproduce. Here's a better way. First draw the panel lines lightly with a straightedge and pencil. Put a quantity of thick black or dark brown acrylic paint (the tube variety that artists use) into a fine-tip syringe and, using the straightedge as a guide, deposit a thin bead of paint along each line. Varying the pressure on the plunger will cause the bead width to be irregular, just like real tarred seams. When the acrylic paint dries, it will be slightly lumpy, just like the original. If it is too lumpy, tamp the seams down lightly while still tacky with a moistened finger, but bear in mind that the acrylic paint will shrink as it dries.

Unless your airstrip is brand new, weather it. As asphalt surfaces get old, they crack and crumble at the edges and display blotchy patches where potholes have been filled. Concrete gradually cracks and discolors, and grass often pokes through the seams in lightly traveled areas. Cracks can be

cut or scribed into the surface with a craft knife or scribe, and grass added with white glue and Static Grass. Simulate discoloration by allowing the initial concrete color to dry thoroughly, then giving it a liberal wash of thinner. While the thinner is still wet, brush on additional concrete shades, allowing them to feather out into a subtle effect. If your scene is posed where aircraft are serviced, add oil and solvent stains. These are made by lightly tapping a brush full of thinned black paint against your finger while holding it 6" from the runway surface. The amount of paint in the brush, the force with which you tap, and the distance from the ground will determine the number, size, and spacing of the oil spots.

The easiest way to paint runway markings is to spray them, either with an airbrush or an aerosol can, but they can be hand painted if you are careful. When spraying, the easiest form of masking is a wet-paper mask. Position strips of really wet paper (any kind, as long as it's not stiff—even facial tissue will do) the requisite distance apart, soak off excess moisture with a paper towel, and spray. The moisture will hold the paper in place long enough to do the job, and it's easy to remove afterward.

Special terrain situations. The basic methods we have discussed are fine for fairly level ground, but what if you want something with more rugged

contours? I'm not talking about mountains, or even foothills, but simple things such as gullies, foxholes, and shell craters. If these features will be no deeper than the thickness of your base they present no great problem; simply cut away enough of your base to make room for them. Use a router, power drill with a $\frac{1}{8}$ " or 1" spade bit, or a hammer, wood chisel, and muscle. You are going to cover the holes with Celluclay anyway, so the cutout areas need not be neat. To accommodate deeper holes, add ridges to the bottom of the base. Drill or cut completely through the plywood and form the depression with wire screen or plaster-impregnated bandage tacked over the hole. Then landscape as usual.

A useful feature created by this method is a dry wash. These gullies are created where rainwater washes away the earth because there is no vegetation to prevent erosion. A dry wash is usually a shallow depression, often quite wide and with small "cliffs" at the sides. Its primary advantage as a design element is to provide a convenient excuse to put certain parts of your scene on abruptly different levels. A dry wash on a diorama can be made either by cutting a depression in the base or by adding higher terrain above it.

Small rises can be made with thick applications of Celluclay, but thick sections can take weeks to dry. You are better off to build up underneath with



Plaster-impregnated bandage is used to make casts, and is available from surgical supply houses and art supply stores. To use it, lay out ground contours with paper towels, newspapers,



or blocks of wood, hold them in place with masking tape, and apply the wet bandage. When dry, apply groundwork as usual over the terrain contours.





This foxhole was constructed using plaster-impregnated bandage, with a masking tape "cup" forming the foxhole.

blocks of wood or rocks. If the hump extends to the edge of the base, end it neatly with a simple plywood or basswood riser veneered on the outside. Prominent hillsides or other high features can be modeled with the plaster-impregnated bandage material used to make casts. Arts and crafts stores carry Pariscraft, a brand of plaster-impregnated fabric used as an art material.

Large rocks are easy to model. You can use natural rocks, but be sure to select pieces that are rough and jagged, not smooth or eroded. Coal makes excellent stratified rock when painted, as does redwood bark. To be convincing, whatever you use to represent rocks must be carefully embedded in the terrain; rocks are revealed by erosion, not dropped by helicopters. If you want to model a cliff face, you will have to be careful in the rocks you select and the manner in which you assemble them. They should look as if

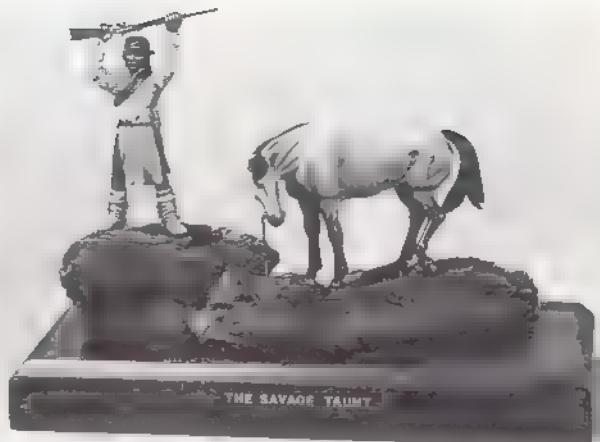
they are all part of the same large section of bedrock. Model railroaders have developed a number of ingenious ways to build large rock faces. Bill McClanahan's *SCENERY FOR MODEL RAILROADS* describes these methods and includes other useful information that is applicable to dioramas.

Celluclay alone is often sufficient to model rich, smooth soil, such as plowed fields. Add a few small pebbles to simulate clumps of dirt, but avoid using sand. Plowed furrows can be made individually with a pencil for large scales or collectively with a comb for small scales. If you model armor, remember that tanks tear up the landscape, particularly soft ground and lush grass. Even the lightest armored vehicles completely shred sod, leaving pairs of deep brown furrows in their wake. You can simulate this on your dioramas by

using the models themselves to impress track marks in the ground.

Snow. Snow has a powdery surface that plaster alone fails to duplicate. One traditional method for simulating snow is to sprinkle the surface of wet plaster with dry plaster or flour. Flour will yellow with age, but dry plaster works fairly well, although it often looks rather lumpy. I have achieved successful results using Celluclay. Just smooth it over carefully and paint it white. Small patches of sand sprinkled in a few depressions and painted muddy brown simulate bare spots in the snow cover. Use the dry-brush technique to feather the border between the mud and the snow because a sharp edge there is not realistic.

Tall grass. Unraveled hemp rope makes excellent ordinary grass in the large scales and buffalo and swamp grass in the smaller ones. The best



Kaumback Books Mike Schaler

Several materials are suitable for modeling weathered rock. Here, Dr. Harold Auerhan has used California redwood bark.



The snow in this Battle of the Bulge diorama is Celluclay painted white. To simulate areas of bare ground, I sprinkled on small patches of sand, painted them brown, and dry-brushed white around the edges to make smooth transitions.



Theatrical crepe hair looks like this before it is stretched and straightened.



This tree stump was made from a dowel cut in lumberjack's zigzag fashion, then detailed with epoxy bark and splinters.

material I have found for tall grass in 1/32 or smaller scales is theatrical crepe hair, a material used in the theatre for making false beards and moustaches. It comes in a braided rope and is available wherever theatrical makeup is sold. Several years ago I found a really nice mousy blond color, ideally suited for grass. I've used it a lot and still have more than half the rope left.



Model railroaders pioneered this technique for making tall pines. The tapered trunk is formed from a dowel, textured with spackling paste, and drilled for asparagus fern or Caspia branches.



Although lichen is difficult to use for trees in larger scales, I found it quite effective in this scene of the fighting in the Normandy hedgerow country.

To work with crepe hair or hemp rope, first straighten it. Unravel a generous length and soak it in warm water, then stretch it out on the floor with a book or similar weight at each end to hold it taut until it dries. For short scrubby grass you can use crepe hair without straightening.

Before installing tall grass of any sort, color the Celluclay. Otherwise, there will be small patches of natural gray color that are nearly impossible to cover with paint around the "roots" of your grass. Celluclay can be colored by adding a small amount of dry powdered color (available at model railroad shops, hardware, and paint stores). Add powder to the Celluclay mixture a little at a time until the desired color is obtained. The exact shade you end up with is not critical since you are going to paint over most of it anyway—the important thing is to eliminate the gray. A mixture of green and orange food coloring is an adequate substitute for dry pigment, but it may turn dark as the Celluclay dries. The final step before putting on grass is to sprinkle sand on the earth surface.

I have never cared for the traditional method of installing tall grass, which is to drill a series of holes and to push the fiber into them. Unless an awful lot of holes are drilled, this results in unrealistic small clumps that sprout from bare ground at regular intervals. The gluing method I use gives a more natural appearance with less effort.

Begin installation by spreading a generous amount of white glue over an area about 2" square. Using scissors, cut a tuft of crepe hair and press the end into the glue. Add more tufts until the patch of glue is covered, then apply more glue and repeat. Try to keep your grass about the same overall length,

you can go back after the glue has dried and trim it to irregular lengths with small scissors. While the glue is still wet, you may want to stir the grass strands with a pencil so that it does not all appear to be growing in the same direction.

Trees. Low vegetation is rarely a problem in dioramas, but trees and bushes are another matter. The difficulty is primarily one of scale. In small scales, a general representation of the irregular shape of the tree and a certain transparent looseness to the foliage are all that are required to make a convincing tree. In larger scales, 1/48 and up, the viewer is able to make out individual leaves, and the traditional model railroad materials tend to look too little like trees and too much like what they are—lichen and foam.

Trunks and branches present no problem; small roots provide an excellent source of both. These can be gathered anywhere when the ground is soft. A single afternoon spent with a small shovel and a shopping bag should provide enough roots to last a couple of years. Look for small shoots and saplings about 2' or 3' high. The quality of the roots will vary from one species to the next. Bushy roots are best; the more branches and little tendrils the better. Be careful not to damage the roots. Wash off the dirt with a hose and let them dry thoroughly in the sun before storing them for future use.

The real problem with trees is foliage. Lichen and shredded foam with fiber matting to hold it together can provide adequate but rarely spectacular foliage, and both must be used carefully. Hobby shop lichen is usually a dreadful color and must be re-dyed in



Moss of various sorts makes excellent foliage and effective camouflage.

a weak solution of orange or brown fabric dye to tone down the green. Tear the lichen irregularly to break up its neat round shapes before gluing it to the branches. Foam is easier to work with, the colors are better, and the matting material can be pulled and stretched into irregular and realistic shapes.

The most effective foliage material for larger scales is a form of scraggly moss, but even this is better suited to scrub trees than mighty oaks and spreading chestnuts. Effective large trees can be built using a large root and several layers of this moss, but really good results require a lot of time. Each bit of moss must be carefully selected and glued in place. If you embark on a project like this, don't expect to finish it in an afternoon.

Fortunately, large trees are rarely

needed on dioramas. In 1/32 scale, a 40' oak is 15" high, big enough to overpower any scene beneath it, so from a design standpoint, you are better off sticking to relatively small trees. You can avoid the foliage problem altogether by modeling dead or shell-splintered trees, or by setting your scene in winter or late fall when limbs are bare.

Evergreens present a slightly different problem. Mosses and ferns, especially asparagus fern, make good evergreen foliage, but it is difficult to find good trunks. For evergreens, you will have to make trunks. For small bushy trees this is no problem; since little of the trunk will be visible, a simple armature of twisted wire is adequate. Larger trees, particularly airy and open types of pines, are construction

projects in their own right. A dowel will have to be whittled to a point and holes drilled for the branches. Bark texture can be added with acrylic modeling paste or epoxy putty, and branches cut from roots glued into the holes. Finally, add foliage. The results are spectacular, and you will not need many such trees for a diorama.

Modeling water—sculpting techniques. The traditional method for modeling water is to form plaster or other material to the desired shape and texture, paint, and use a high-gloss varnish over the paint to achieve the wet look of water. The advantage of this technique is that you can carve or sculpt waves or ripples into the surface with great control. The base material you choose will depend upon the size of the area to be covered. Plaster is best suited to large (2 or 3 square feet), relatively flat bodies of water. The plaster should be distinctly goopy in consistency, easily poured yet still having some body. Shallow waves and ripples can be quickly worked into the plaster with a putty knife, pencil, rubber spatula, or any tools that seem to work. If you want to retard the setting of the plaster to give you more working time, a few drops of vinegar will do the job nicely. It's wise to run some experiments first, because the effect of vinegar on different types of plaster varies.

Epoxy putty or other sculptable materials are suitable for modeling rough water, but they are expensive and time-consuming for large areas. Epoxy putty is the most effective material for simulating heavy seas in ship dioramas. Sculpting epoxy is not terribly difficult, but it does take time. The best tool I have found is a round, blunt-pointed rod; even a pen cap can do the job. The shape of the tool will vary with the scale you are working in:



The realistic jungle growth in this dramatic Corregidor battle scene by Steve Gilbert consists of roots, moss, and twigs, supplemented with palm fronds cut from thin paper.



The flat water on this diorama was made by painting the base an appropriate muddy green color and applying several coats of high-gloss varnish.

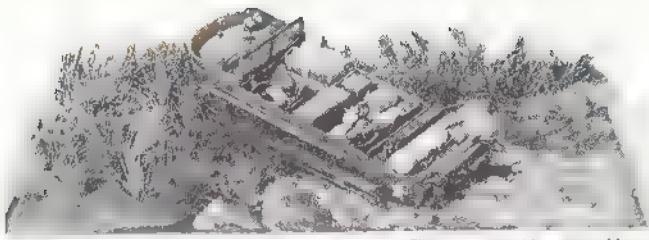


Photo courtesy, Monty and Mose's

To make the sculptured water on this diorama, the model was embedded in the first layer of plaster. The second layer of plaster was formed into waves with a screwdriver before it set.

John Leyland's "The First Shot" diorama uses poured polyester casting resin to simulate water. The foamy wake and underwater explosions are white acrylic paint.

the smaller the scale, the sharper the tip. Experiment with different sizes and shapes until you find the ones you like best. Be careful to apply only the amount of epoxy you can comfortably complete working with before it sets. Large areas may have to be done in several stages.

Sculptured epoxy putty is at its best for rapids and other fresh water applications. No other material is quite as good for violent white water, and the sculptability of the epoxy allows you great freedom and precision in achieving just the effect you want. The biggest disadvantage of epoxy for modeling shallow water is that the material is not transparent, but if you take care in painting you can fake depth quite effectively. Paint the deepest water dark brown, blending this gradually into yellowish brown or rock color where the water is shal-

lower. The blending should be subtle, and is best accomplished with an air-brush or brushed artist's oils. When the colors are thoroughly dry, give the water several coats of gloss varnish and paint in the white water. White water is not all white, much of it is translucent, so the best way to simulate it is to thin white paint considerably, and use successively thicker paint as you work closer to the heaviest bubbles and foam. Use unthinned paint and a stabbing, stippling action with a stiff brush to simulate froth and foam.

If you are modeling oceans, you should know how they work. Ocean waves are caused by wind blowing across the water. These seas travel in the same direction as the wind until they lose their momentum and fade away, and the wind that causes the seas need not be in the immediate area.

Seas are not the same as rollers on a beach; they tend to be higher, often much higher, and do not break at regular intervals. The ocean surface is an irregular series of parallel ridges crisscrossed by innumerable small ripples. There are no level areas; the water is always moving either up or down. The height of the seas can vary from 1' to as much as 60'.

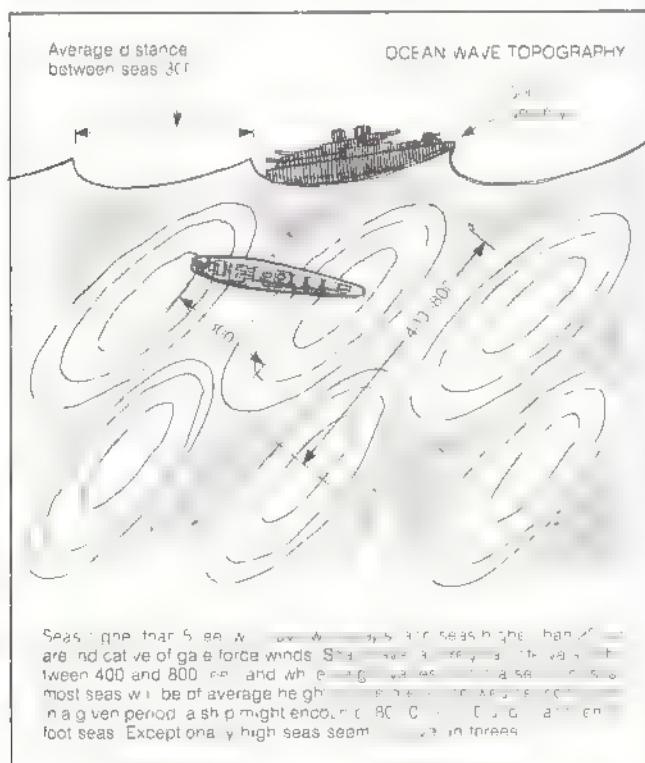
In ocean dioramas you only need to pay close attention to certain aspects of ocean waves. Since seas travel in the same direction as the wind, make sure that all flags are blowing in that direction, too. If your diorama includes sailing ships, make sure that the set of the sails is consistent with the wind direction. You can reduce the distance between seas by as much as half without making them appear grossly unrealistic, a good thing since even in 1/1200 scale, an 800' interval is 8'.



Kamibach Books Mike Schaefer



The TBD-1 Devastator diorama features ripples made by pressing crumpled aluminum foil into the final layer of clear resin.





These examples show water sculpted in epoxy putty. Cy Bro-
man's 1/600 scale China gunboat (left) and my 1/1200 sixteenth-



century carrack show how different colors are required for different situations. The muddy river water is especially effective.

Ocean water colors are shades of blue or green, depending upon the color of the sky. Stormy seas are gray. Keep at least a touch of green in your color; even the Pacific and Mediterranean, famous for their bright blues, tend toward turquoise. Dark blue seas don't look realistic. I generally paint sculptured oceans with water-base paints and use an airbrush to add color variations, either to indicate shallows or just give a pleasing effect. When dry, I apply several quick coats of clear gloss spray lacquer.

Modelling water—pouring techniques. A technique for modeling water that is gaining great popularity is the use of clear polyester casting resin. This is sold in craft shops for embedding objects in plastic. The great advantage of resin water over sculptured water is that resin is transparent, providing a representation of depth. Objects can be partially or completely embedded in the resin, making them visible both above and below the surface. Polyester resin is ideally suited to modeling slow-running streams, shallow pools, and other water where the bottom is clearly visible. The resin can be tinted with dyes, and an enhanced effect of depth can be achieved by tinting the lowest layer and then making each successive layer lighter until the top layer is perfectly clear. Murky, muddy water can be made by tinting the resin with ordinary hobby enamels.

Polyester resin does have its disadvantages. First, its shelf life is only a matter of months, so don't buy any more than you need for the project at hand. Second, the stuff stinks to high heaven and the vapors are toxic. Always work in a well-ventilated area. Third, the material sets by a catalytic reaction that can generate a good deal of heat. Pouring it in layers thicker than $\frac{1}{8}$ " can cause it to crack at the edges or, worse still, melt the models embedded in it. The resin is a powerful solvent, so test it out thoroughly on any paint or plastic with which it will come in contact. The resins I have used

do not seem to affect bare styrene or models painted with water-base paints such as Polly S. Always run a few tests with any material that will be touched by polyester resin.

For applications where the bottom is to be visible, landscape the bottom just as if it were dry land, and paint it with water-base paint. When this is thoroughly dry (wait an extra day or two to avoid any possibility of trapped moisture), pour the resin in successive $\frac{1}{16}$ "- $\frac{1}{8}$ " layers, tinting if you wish. Whether you tint the water with dyes is a matter of personal taste. For fresh water shallows, a weak golden brown tint can be achieved by mixing small amounts of green and orange dye.

Mix the resin according to the directions. Use a paper cup (no Styrofoam—the resin will melt it!) about half full and add the appropriate number of drops of hardener. How long the resin takes to set will depend upon how much hardener you add. Too much hardener will speed up the reaction and generate heat which can craze the surface of the resin or melt a model embedded in it. Too little hardener can cause the resin to take as long as a day or two to set. A setting time of 45 minutes is about right. The second layer can be poured while the first is still tacky, but watch for heat buildup; feel for heat by holding your hand $\frac{1}{4}$ " from the surface.

Small ripples can be worked into the top layer of polyester resin water with a rubber spatula or similar tool, but you will have to work fast because once the chemical reaction starts there is a swift progression from liquid to gel to solid. There will be only a few seconds when the resin is thin enough to take ripples yet thick enough to hold them. To eliminate stickiness on the surface of the final resin layer, subject it to a bit of warm heat. Positioning a 100-watt light bulb a few inches from the surface of the water or leaving your diorama on top of the furnace for about an hour is sufficient.

While casting resin can be used for large bodies of water, it is not well

suited for modeling rough seas because its natural tendency is to level out. If your diorama calls for high seas with a distinct succession of waves, you are better off working with varnished putty or plaster. Low, choppy seas,



These are the steps in the resin and foil method. First, a shallow diorama tray is lined with aluminum foil. After the first resin pour, the model is embedded in it. The foil is pressed into the final layer.

however, can be simulated effectively with polyester resin. Here's how.

Begin by building a shallow tray to contain your ocean. This is best built as a permanent fixture part of the display base. Stain and varnish the base and carefully seal the inside seams of the tray with 5-minute epoxy. Paint the inside of the tray blue or green with water-base paint and pour the resin in the usual manner, tinting it to the desired color, usually a greenish blue. Mix in a little less hardener than usual and allow more time between layers to ensure that the resin will not shrink away from the border. Insert your model at the appropriate layer.

The final layer of resin can be textured in two ways. The first is the same poke-and-pull method used for epoxy putty. This method is adequate for calm seas, but you have to work fast, and with an ocean scene you may have a lot of area to cover. In a ship scene, don't forget to add bow waves and wake. Foam and white water around the ship can be painted in once the resin has set.

A far more effective way of texturing the final resin layer is to use crumpled heavy-duty aluminum foil as a press-on mold. Crumple the foil to represent ripples in your scale—the smaller your scale, the more you should wrinkle the foil. Crumple enough foil to cover the entire surface of the diorama. Pour the final layer of resin and push the foil down onto it. The dull side of the foil will give your sea a matte, windblown surface, while the shiny side will give a glossy surface. It will probably take several foil sections to cover a large base. If you use sections, tear the foil to avoid straight edges in your sea. Be very careful that no resin creeps over the edge of the foil, because if it does, when the resin sets the foil will

be permanently embedded in it, a shiny silver reminder to be more careful next time.

When the resin has set, peel away the foil and examine the surface closely. Air bubbles, open spaces, and other imperfections can be patched with drops of resin and swatches of foil. Press the foil down securely to avoid leaving conspicuous circular patches. For scales larger than 1/72, brush on a final thin coat of resin to round out the bottom of the wave troughs for a liquid appearance.

When using the foil technique do not embed your models in the resin if there is a way to avoid it. Working the foil around the edges of the model, particularly small, delicate models, can be tricky. Instead, wait until the water is completely textured and position the model on the water surface. Trace the outline of the model with a scribe, grease pencil, or marking pen, and use a Dremel tool or other hand grinder to cut out a recess for it. For ship models with hollow bottoms, you need only cut a groove of sufficient width to accommodate the edge of the hull. A small amount of resin can be poured into the recess and the model settled in, or the model can be glued in with 5-minute epoxy. The final touch is to paint in white water where necessary.

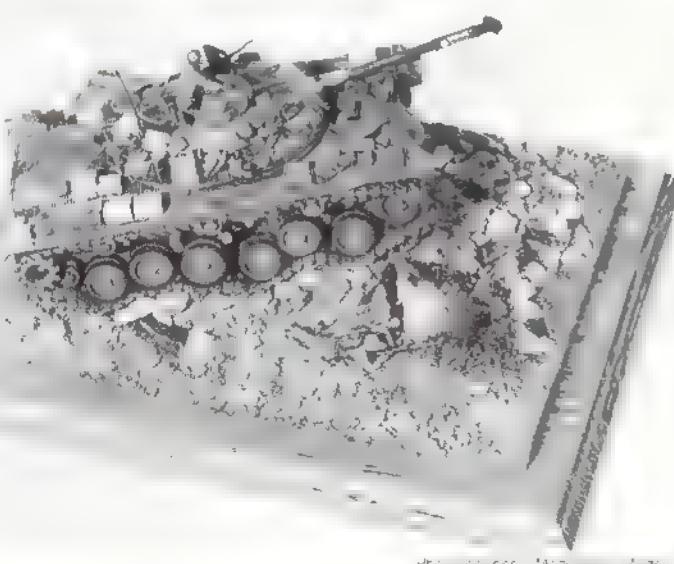
The crumpled foil technique can also be used for swift-running streams, provided they are fairly level. Twigs and branches can be added by drilling holes in the finished resin and setting them in with resin or glue.

The simplest way of modeling small quantities of water is to use 5-minute epoxy glue. This is ideally suited to ultra-miniature ship model dioramas (1/2000 scale and smaller) and for small streams and rivulets in larger scales. Some epoxies leave a mottled,

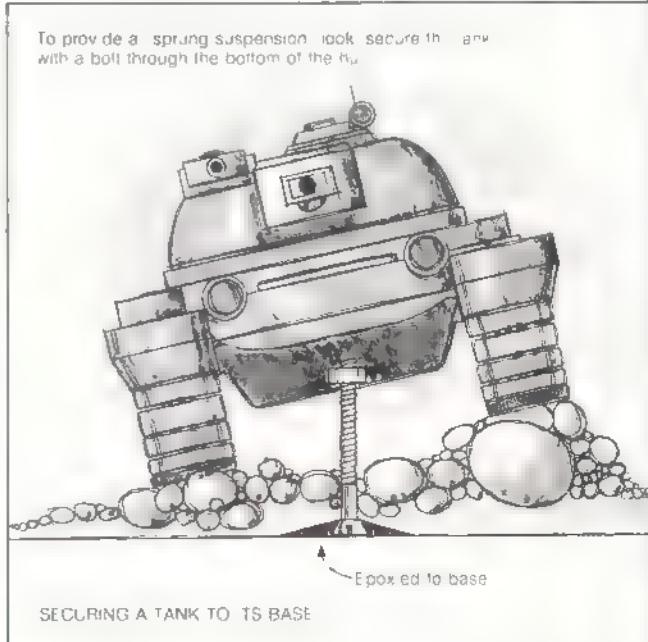
sticky surface, so you will have to experiment to find a brand that provides a smooth, glossy finish. For ocean scenes, paint the base with water-base paints and apply the epoxy. It is best to cover the entire base at once, but bear in mind that you will have less than 5 minutes to manipulate the material. If necessary, smaller areas can be worked and the entire surface then covered with a final thin coat to hide the seams.

As the epoxy begins to set, use a toothpick to pick out ripples and waves. At first these will gently fall back into the surface, but as the epoxy thickens this tendency will diminish and the waves will remain. Like polyester resin, epoxy is limited to fairly calm seas, and you can't use the foil trick. Epoxy is also good for other small areas of water—buckets, cups, and puddles. The biggest problem in these small situations is the natural tendency for epoxy to crawl up the sides of the container. This is called capillary action, and there is not much you can do about it, other than applying the epoxy in two or three layers.

Fastening models to the base. There are a number of ways of attaching your models permanently to the diorama base. The easiest is just to glue them with white glue or epoxy. If you use epoxy, be sure to touch up any glossy spots with flat varnish. While aircraft models can simply be glued to the base, because of their relatively small area of contact, they are likely to break loose when you can least afford it. For more secure attachment, install pins or short brass wire rods in the wheels of the airplane and drill matching holes in the base. The airplane can then be glued in place, or left secured by only the pins.



Making the tracks of an AFV conform to rugged terrain is a sure way to add dramatic impact to your diorama.



SECURING A TANK TO ITS BASE

Weathering techniques

Many modelers who have never tried weathering have needless misgivings about it. Weathering is not difficult, and careful weathering can cover mistakes in assembly and finishing. There is a lot of truth in the axiom that it is easier to build a dirty model than a clean one. This is not to imply that you can be careless in assembling your models; while weathering will hide certain errors made during assembly, it can emphasize others.

Preparing your model for weathering. During assembly, be sure to remove all visible molding lines and thoroughly putty over and smooth all seams. These flaws may not show on the assembled model, but dry-brush weathering will make them stand out, as it will glue stains and other surface blemishes. Give your finished model a primer coat and then inspect the surface carefully for flaws.

The paint coat on your model will be subject to a lot of abuse, both chemical and physical, during weathering. Both scrubbing action and the use of thinners can lift paint that has not adhered properly to the plastic. Using different types of paint (water-base, lacquer, and enamels) for the initial painting and weathering processes will help eliminate chemical lifting. Before painting, wash the assembled model thoroughly with detergent and a soft brush to remove silicone parting agents remaining from the molding process. Consider painting the base coat with a

lacquer-base paint, such as Floquil. This type of paint has a solvent action that provides a "bite" on the plastic surface. Lacquer should be applied using an airbrush so the paint will dry before its solvent crazes the plastic.

An airbrush is an absolutely worthwhile investment for diorama work. There are certain jobs that only an airbrush can do, such as painting intricate camouflage patterns or achieving a smooth, even paint coat on delicate detail, but an airbrush is also an enormous time-saver. An armored vehicle that takes an hour to paint by hand can be painted with an airbrush in about 5 minutes. The dead-flat varnish oversprays so important in modeling can be applied effectively only with an airbrush. An airbrush also provides a slightly pebbled paint surface; such a surface has a property called "tooth" that facilitates dry-brushing.

The manner in which you apply decals will have an effect on your weathering. Using decal-setting fluid to snuggle the decal film down against the surface of the model is imperative, but even this step will not eliminate the tiny ridge of film around the edge of the decal. As soon as you start weathering, the decal edge shows. Carefully trimming excess decal film helps, but whenever possible try to use "disappearing film" decals such as those offered by Micro-Scale. These require no trimming, and their application

system effectively makes the film disappear. The surface over which you apply decals is especially important. While most model paints provide a flat finish, a glossy surface is best for decals. For this reason, I often paint my models with glossy paints. After applying decals, I then overcoat the entire model with matte varnish.

Matte varnish is also used to correct unintentional gloss finishes and to provide a uniform surface coating on a model prior to weathering. Unfortunately, I have yet to find a 100 percent reliable dead-flat varnish; even the best brands go bad occasionally. Whatever brand you use, never take it for granted. *Always test matte varnish on glossy scrap to make sure it still works before applying it to your model.* Matte varnish that has gone glossy, or worse still, turned white, can ruin any model, and the damage is virtually impossible to correct.

Finally, you must never try to weather over paint that has not fully dried. This is important. After painting and decaling your model, allow time for the model to cure completely before weathering. A curing period of 2 or 3 days is usually long enough, but leaving the model alone for a week is even better.

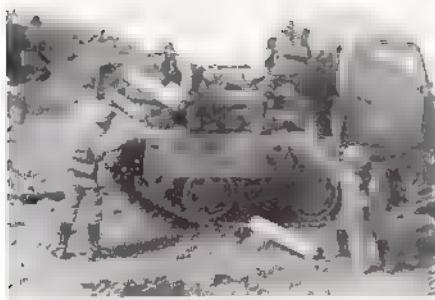
Four basic weathering methods are sufficient for most situations: washes, dry-brushing, airbrush effects, and pastel chalks. We'll discuss each technique in detail, then go on to show how



François Verlinden of Belgium has developed a delicate dry-brush technique that brings out even the smallest details.



Weathering will accentuate decal film, so be especially careful when applying decals to models that are to be weathered.

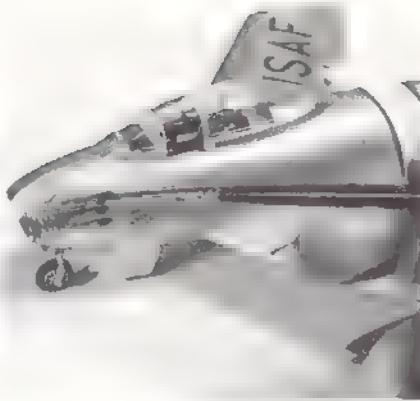


Dave Smith has used dry-brushing to bring out the wood grain in the cargo bed and the molding around the cab door on this transporter model.

they are applied to different models. Once you understand the basic techniques, weathering is largely a process of experimentation. You'll find that the techniques you use will differ not only from one type of model to the next, but also among models of the same type.

Washes. The first step in weathering is often the application of a wash over the basic paint. This is nothing more than greatly thinned paint that is flowed over the surface so that it accumulates in corners and recesses. Although the primary purpose of a wash is to accent surface relief and bring out detail, washes are often used to simulate oil, grease, and other stains and to alter base colors.

Certain types of paint and thinners are better for washes than others. It is usually wise to stay away from Floquil because Diosol is a powerful solvent that may lift or soften the paint on the model. Washes made from water-base paints have a peculiar habit of looking great when you first lay them on, but often dry to a blotchy, unattractive finish. Although they occasionally



Pastels are excellent for exhaust stains and powder residue on aircraft.

turn glossy, paints thinned with turpentine or mineral spirits are my choice for making washes. Experiment with hobby paints and thinners until you find the one you like best. Don't rule out artist's oils, either.

First give your model a light brushing overall with thinner to prepare the surface for the wash. While this dries, mix a small amount of color with a lot of thinner to make the wash. Exact proportions are not important, but what you really want is not thinned paint but tinted thinner. To accentuate detail, make your wash with a darker shade of the basic model color. You can use a black wash, but it is better to add a bit of the basic model color to black. Use a wide soft brush to flow the wash freely onto the model, letting it run into all the small cracks and crevices. Excess wash can be removed by soaking it up with paper towel, but be careful to leave a generous accumulation in the recesses. You may want to wipe some areas clean with a dry tissue or cloth. It is best to apply the wash to large, clearly defined sections of the model; doing small, undefined areas



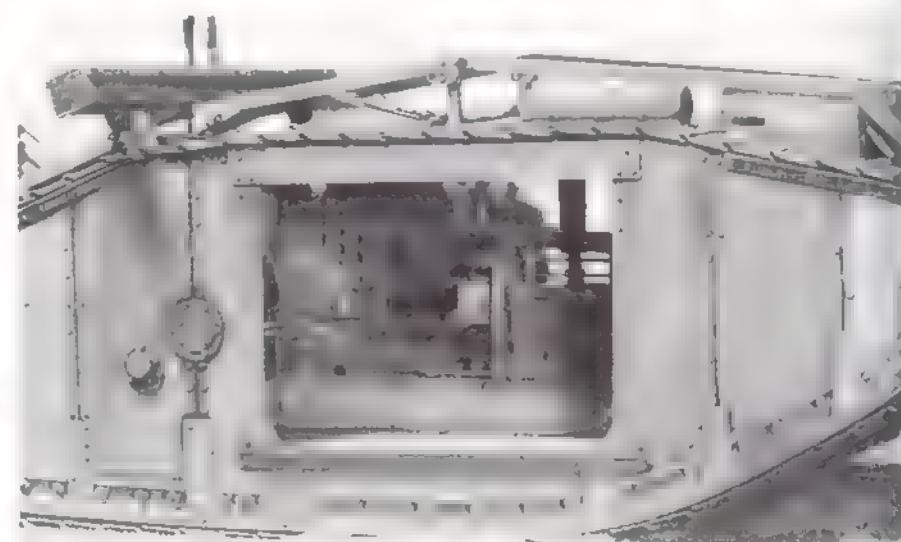
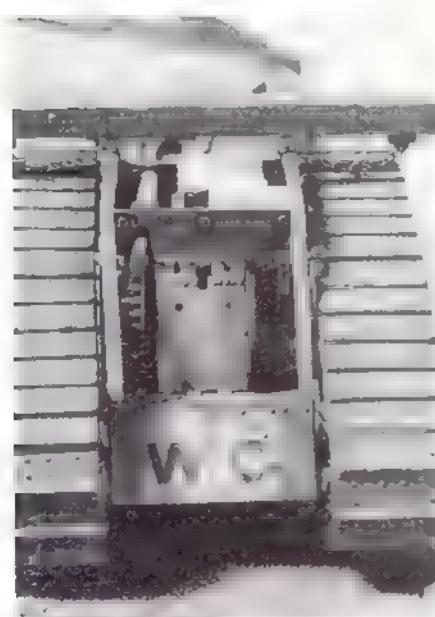
The clean areas on the windshield of this jeep were made by masking them and overspraying the model with an airbrush.

results in blotches with irregular borders of paint around them when they dry.

To simulate oil and grease stains, use more concentrated washes. Apply these stains with a brush in the appropriate areas, brushing the stains downward if they would run and leaving irregular blotches if they would not. You can apply several different colors to adjoining areas at the same time, allowing them to flow together at the edges for an interesting and novel effect.

When laying on your washes, be careful not to overdo it. You want a darker color in the recesses, not straight black. When you dry-brush the model later, the contrast between surface and recessed detail will be increased, and what may look like insufficient contrast after only the wash may turn out to be just right.

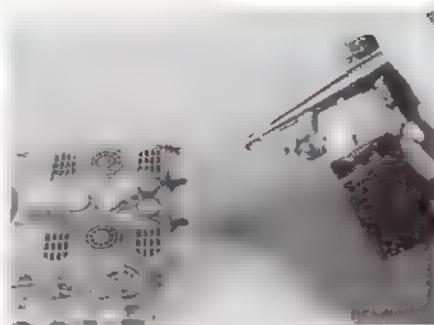
Dry-brushing. Dry-brushing is the technique of using an almost-dry brush to apply paint to the raised detail of a model by lightly whisking the brush back and forth over the surface. Dry-brush weathering is a refined version



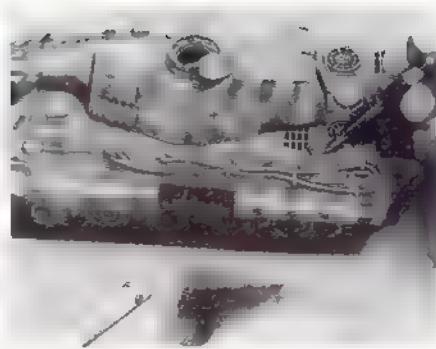
Note the oil stains, grease residue, rust, and other subtle weathering effects on Jim Stephens' exquisite scratchbuilt WWI Mark IV tank.



Effective dry-brushing utilizes a scrubbing motion with practically no paint on the brush. Start by stroking gently, then bear down with increasing vigor as the paint on the brush is depleted.



An airbrush is handy for tasks such as blackening exhausts. The one I use is a basic, single-action model that doesn't clog nearly as easily as the more elaborate double-action brushes.



Pastel chalk is by far the most subtle weathering agent in our inventory. To use, grind the chalk to powder and apply the powder with a soft brush

of the same technique we use on the groundwork. The brush we use should be softer, and the effect achieved more subtle and delicate.

The two factors that control the quality of the effect achieved by dry-brushing are the amount of paint on the brush and the consistency of the paint. If there is too much paint on the brush, it will leave a solid patch of color on the model rather than a light frosting. If there is too little paint on the brush, it will leave nothing at all. You can regulate the amount of paint on the brush by lightly stroking the brush back and forth a few times on a scrap of card or cloth before touching it to the model. The second factor, the consistency of the paint, is also important, because if the paint is too thin, even if there is the right amount of paint on the brush, the brush may leave streaks. If the paint is too thick, it will be reluctant to leave the brush, and the brush will deposit rough, chunky blobs of paint on the model.

The desired result of dry-brushing is a smooth and subtle gradation of color, and the type of paint you use can have a lot to do with how well you achieve this. I suggest you experiment with several paints until you find something you like. I get some of my best dry-brushing results with artist's oils, but they take longer to dry than hobby paints. Others mix oils half-and-half with hobby paint, while some modelers use straight hobby paint. Water-base paints can also be used.

The colors you use for dry-brushing will vary from one model to the next. If your model has a camouflage pattern, you will have to dry-brush each of the different colors separately. A good color to start with is a lighter shade of the basic color on the model. Add white to the basic color, adjust the amount and consistency of paint on your brush, and stroke the brush lightly back and forth over the surface of the model. After you have dry-brushed the entire model, add a bit more white to the paint and repeat the process, this time stroking more lightly and catching

only the higher raised detail. Step back, examine your work, and dry-brush again with an even lighter color if necessary. Engraved detail which was barely visible under the basic color should now be highlighted beautifully.

The next step is to repeat the dry-brushing treatment with some of your terrain base color, gradually lightening it as you did the basic model color. Apply the earth shade in subtle irregular blotches, bearing in mind that dirt splotches are most prevalent near the ground. Vary the color of these blotches, adding a bit of brown to the color here, a touch of green there. This avoids a monochromatic look and gives the model realistic "spark." This dry-brushed ground color provides a direct visual connection between the model and the terrain beneath it. This is important, because you want the vehicle to look as if the dirt on it came from the ground.

Effective dry-brushing, more than any other weathering technique, is a

matter of "fiddlin' around" until the model looks right. You may find yourself dry-brushing the same area half a dozen times before you get just the effect you want. Don't be afraid to experiment; it is the only way to learn any weathering technique.

When you are satisfied with the dry-brushing effect, allow several days for the paint to dry. When the dry-brushed color is completely cured, you can apply washes over it to tone it down if there are areas where you feel the dry-brushing is too harsh or the color isn't quite right.

Airbrush hazing, feathering, and fading. Most of my weathering is done with a brush, but the airbrush does come in handy once in a while. The forte of an airbrush is applying evenly colored stains with feathered edges, such as soot around exhaust pipes, powder burns around gun muzzles, and grease stains with faded, indistinct edges. The airbrush can also be used as a substitute for a wash to tone down



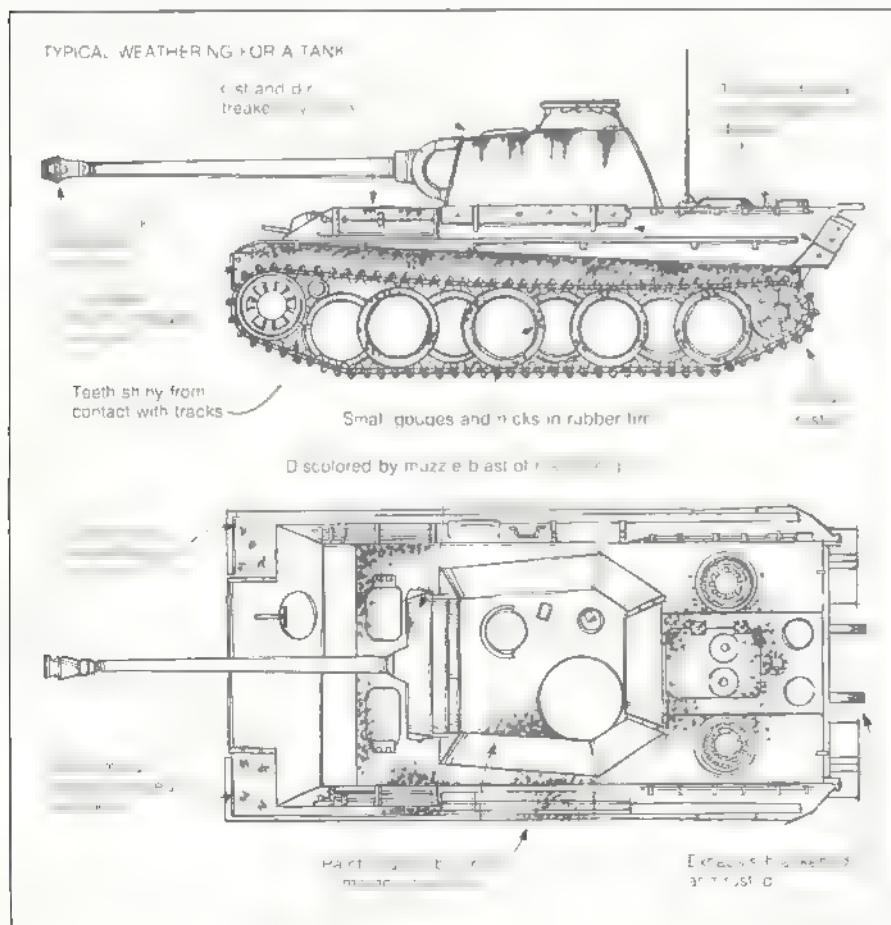
The faded upper surfaces on this Me109 were done by lightly overspraying them with a slightly lighter shade of the color used on the rest of the aircraft, then adding subtle variations of the basic faded color with pastel chalks.



My weathering treatment on this Tamiya 1/25 Tiger I includes bent fenders, blackened muzzle, and liberal use of ground color on the lower parts of the tank.



Tanks can take a tremendous beating and remain in service. This Tiger by Dave Smith has bent and missing fenders, peeling zimmerit, and a dangling tow cable.



exaggerated dry-brushing. An often-touted use for the airbrush is for applying "dust," but I find that unless the situation calls for a very recent, even dust coating, the effect is unrealistic. Real dust accumulates in corners, crannies, and crevices, and is wiped or blown off exposed surfaces, and this distribution can't be simulated adequately by a couple of passes with an airbrush. While it is not a good duster, the airbrush does do an effective job of "fading" painted surfaces, an operation which calls for a smooth, somewhat transparent coat of color—just what the airbrush is designed for.

To use your airbrush for weathering, thin the paint more, and set your air pressure higher than for ordinary painting. Coverage and opacity are not factors at all, and you want soft feather edges wherever one color meets another. Always experiment on a piece of scrap to be sure the paint consistency and air pressure are correct before using the airbrush on the model. For grease and other stains, simply mix an appropriate color and spray it on in the desired pattern. Simulating faded paint is a little trickier. Light tan or gray is the best color for most situations, and the paint should be even thinner than is usual for weathering. Spray a very light frosting over all upper surfaces of the model, including decals, gradually increasing the coverage until you achieve the desired degree of fading. Be careful not to get carried away and overdo it—it can't be "un-faded." Use the same method for toning down dry-brushing.

Airbrushing exhaust stains and powder burns on aircraft takes a bit of practice. These stains start out strong at the source and fade out as they are carried back along the fuselage by the airstream. To duplicate this, adjust the spray pattern down to a fine line. Start spraying at the source of the stain, holding the airbrush close to the surface and gradually pulling it away

as you move aft along the fuselage. Practice this effect on scrap until you are confident of your ability to duplicate it on the model. If the stain accidentally becomes too wide, you can thin it by overspraying the edge with the fuselage color.

Using pastel chalks. Pastels are colored chalks which, when ground on a scrap of sandpaper, provide fine powdered color that can be applied with a brush for delicate weathering effects. Many of the effects possible with an airbrush can also be achieved with pastels, and many of the subtle colors and tones possible with pastels are far beyond the capabilities of an airbrush.

Pastel chalks can be obtained at any art supply store. The chalks you are looking for are soft artist's pastels, not hard blackboard sticks. Some shops stock pastel sticks individually, but they are more often sold in sets. A wide range of colors is available. The colors you'll need for weathering are black, white, yellow ochre, burnt sienna, raw sienna, burnt umber, and raw umber. You may want to pick up a few intermediate shades of these, but you can easily mix the powders to make lighter or darker shades.

Grind the chalk to powder by rubbing it on sandpaper, then apply the powder with a soft brush. Don't use an expensive brush, because rubbing it against the sandpaper to pick up the powder will ruin the tip. Broad strokes with a wide brush provide wide, even areas of color, while a scrubbing action gives a blotchy appearance. Using a small brush or the edge of a wide one makes narrow streaks of color. Tapping a full brush against your finger a short distance from the surface gives a spattered effect. You'll be surprised and delighted at the subtle feathered edges and delicate shadings you can achieve. Pastels work better over matte finishes than glossy ones because the matte surface gives the powder something to grip.

Nothing duplicates dust so perfectly as pastels, and nothing is so simple. Just brush the powder on, blow it around a bit, and—because it's essentially dust itself—the material does the rest.

The primary disadvantage of pastels is that they are not permanent. Artists working with pastels usually spray their finished work with a clear fixative, but this is unsatisfactory for models because the fixative spray can drastically alter the colors, particularly light ones, and subtle effects can disappear altogether. Although unfixed colors will not change with age, the powder rubs off easily and shows fingerprints if you handle the model. For this reason, I apply pastels last; in fact, I usually wait until the model is permanently attached to its



Rubber components in armored vehicle running gear won't rust, so carefully research the construction of your vehicle and paint rubber portions, such as road wheel tires, black. Metal parts subject to wear should be rusted bright orange.

base so that the model itself will never have to be handled at all.

Weathering armored vehicles. Tanks and other armored vehicles seem to attract dirt like small children; grubbiness is an essential aspect of their nature. Even a freshly washed tank gets dirty driving the 50 yards from the washrack back to the motor pool. Whenever possible, refer to photographs of tanks in the field to see how tanks weather. These are your best source for information, and will ensure that your weathering is realistic. If something doesn't look quite right when you are done, go back to the photos to see what is wrong.

Since tanks are made of steel, let's start our discussion with rust. The vehicle is painted to preserve it, but areas that are subject to wear lose their

paint and quickly start to rust. Where the climate is damp, rain running down the sides of the vehicle will carry streaks from the rusted areas. The areas most likely to wear are edges, corners, and projections where objects strike the vehicle. Similar damage is done by crew members climbing aboard; there are usually two or three routes which will be badly scratched and scuffed. Because of constant wear, these areas are less likely to rust, but they will show up as bare metal. Shiny metal can be duplicated by gently dry-brushing gunmetal paint (mixed silver and black) onto the surface. Keep the brush drier than usual and use a scrubbing motion. Rusted areas are treated the same way, using a dark burnt-orange color. One or two small spots of bare metal and rust are more than enough.

Tracks are the only parts of a tank that are not painted at all. These quickly take on the color of dark rust, except where the rust is worn down to bare metal by contact with the running gear and the ground. These bright spots will rust bright orange overnight if the tank is not in motion. The best way to rust tracks is to paint them overall dark brown, then dry-brush brighter rust onto the raised surfaces. Finally, dry-brush gunmetal where the rust would wear off. An excellent substitute for gunmetal paint is powdered graphite applied with a brush; rubbing with a soft (No. 0) lead pencil also works. Don't forget the rims of metal road wheels and teeth on the



After painting tracks dark brown, dry-brush them with several shades of rust, then follow with a gunmetal color.



This battle-weary B-17 has finally seen one mission too many. Note the faded paint on the wings, the oil and exhaust streaks,



the mismatched paint covering old wounds, and the chipped paint around the extensive flak damage.

drive sprockets, all of which would be worn bare by the tracks.

Another aspect of weathering armored vehicles is adding terrain texture to them. In dry country the tracks will be covered with dust, and where the soil is moist the entire undercarriage will be clogged with mud. The sides of the hull will be encrusted with a mud layer several inches thick, as will the road wheels, idlers, drive sprockets, suspension arms, and anything else less than 4' from the ground. If the vehicle has recently crossed a field, chunks of turf will be pasted throughout the system. The mud can be duplicated with Celluclay mixed with more white glue than usual and gooped all over the suspension before the model is painted. Don't overdo it; 2" of mud in 1/32 scale is only $\frac{1}{16}$ ". Sprinkle Static Grass over the Celluclay and mush it into the "mud." Paint and dry-brush the mud and turf as if they were on the base, but

remember that mud is much darker than dry earth.

Dry-brushing is particularly effective in armor modeling for applying the overall coating of dust and dirt to vehicles. Start out by giving the entire model a wash of dark green, brown, or black, then dry-brush with a lighter shade of the base color used on the vehicle. Continue dry-brushing using progressively lighter shades until you are satisfied, then dry-brush again with several variations of the terrain color to add dirt, dust, and general grime. You want a rough, splotchy effect, so use a scrubbing action with the brush.

Add black pastel smoke stains around the exhaust system and powder residue on the muzzle brake if the tank has one. Mufflers and exhaust systems rust badly from heat; dry-brush these with rust. You can get an effect of encrusted rust by painting the muffler and, while still wet, dipping it

in baking soda. Then repaint and dry-brush. Pastel dust can be added as a final touch, but don't dust a muddy tank.

Aircraft weathering procedures. Airplanes do not get nearly as dirty as tanks, but neither are they as clean as they often appear at a distance. They may not get covered by mud or dust, but oil leaks out, surfaces get scratched, and paint fades, stains, and chips. The next time you fly on a commercial airliner, take a close look at it. Although it looks immaculate from a distance, when you get up close you can see that the wing surfaces are streaked and the landing gear is dirty and oily. Only private planes and the colorful U.S. carrier planes between the wars were maintained to a really high standard of polish, and even today's private planes are not perfectly clean.

The dirt on aircraft reflects their operating conditions. Combat aircraft which see long service with only



The heavy weathering on this derelict B-25 was done almost exclusively with pastels. Pastels are far better suited to aircraft and small scale models than dry-brushing.



External mufflers on tanks rust out badly. Dents can be added with a steel cutter in a Dremel tool, and the rusty texture achieved by coating the muffler with glue and sprinkling on baking soda



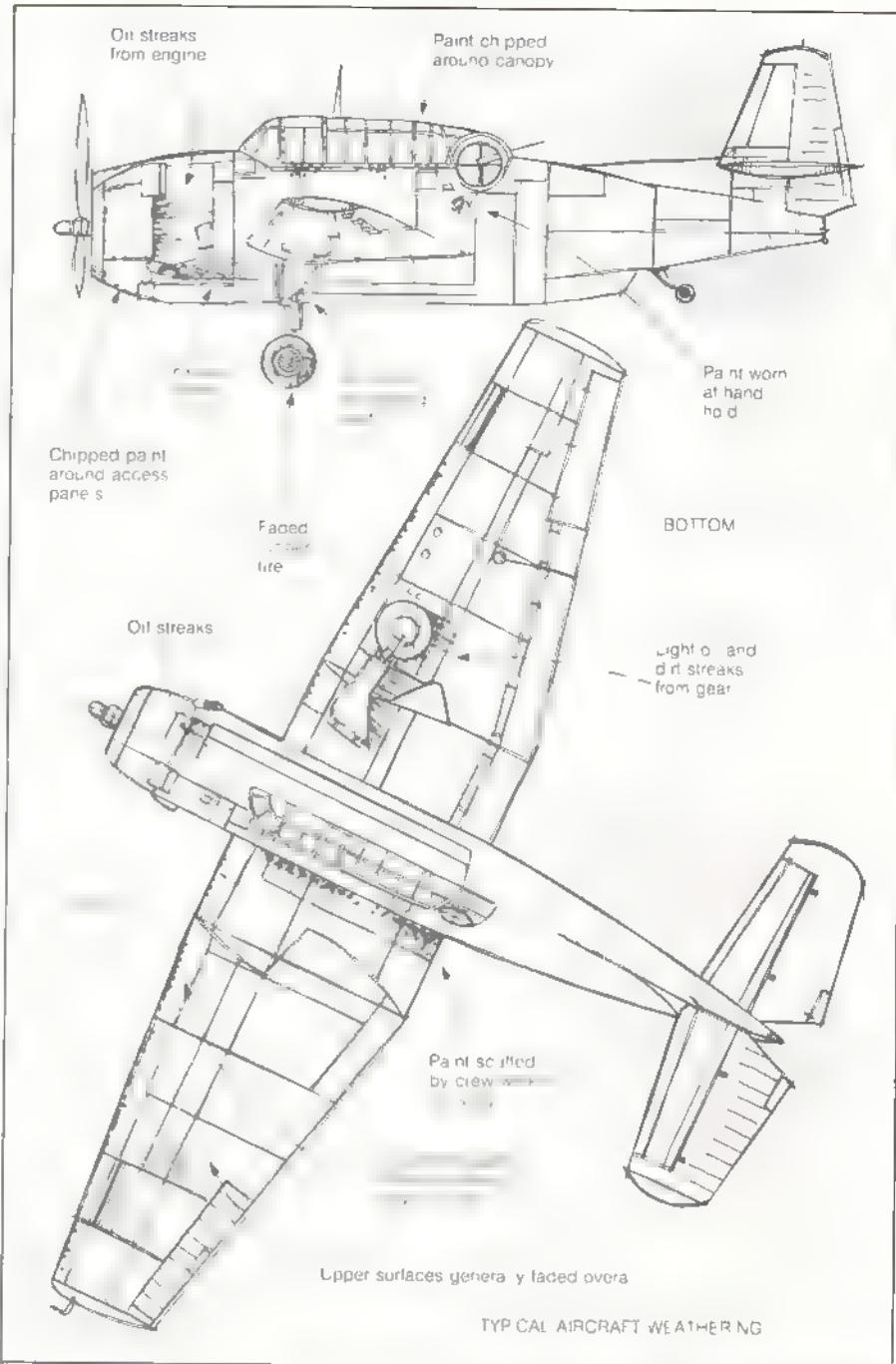
Typical oil and grease stain patterns around the cowling of an Me109.

sufficient maintenance to keep them flying are pretty well battered, while peacetime aircraft that don't log a lot of flying time remain quite clean. Aircraft stationed in arid areas will fade and accumulate dust more quickly than those operating in temperate climates.

How quickly paint fades also depends on paint quality. Certain aircraft were more prone to fading than others. The olive drab used by the U.S. Army Air Corps early in WWII not only faded badly in sunlight but even discolored, gradually shifting almost to purple. Fading and color shifting are best accomplished with an airbrush or pastels.

Worn paint takes two forms: *scuffed* paint, where abrasion has gradually worn through, revealing bare aluminum underneath (usually found alongside the cockpit and other areas where crew members walk), and *flaked* paint, where the finish has pulled off in irregular chunks. Scuffed paint is easy to simulate by dry-brushing with silver or gunmetal. Scuff only those areas where foot traffic is likely (beside the cockpit, near the fuel tanks and ammo hatches) and avoid areas where walking was not permitted ("no step"). Flaked paint is most often found around the engines, where heat gradually weakens the paint and frequent removal of access panels causes paint to flake off around panel edges, screws, and fasteners. Paint also tends to flake along the leading edges of wings, cowlings, and stabilizers. This phenomenon was particularly common in the Pacific, where the prop blast would blow up loose coral from the runway and scour the wings with it. Japanese aircraft were particularly vulnerable to this form of weathering, and planes with nearly half their finish blasted off were not uncommon.

There are several ways to model flaked paint. The simplest is to carefully paint the chipped areas with silver or gunmetal. This is the method



The mud clogging the running gear of these tanks is made from Celluclay that was dyed brown before application. Embedding



grass and various sizes of pebbles in the wet Celluclay adds to the realistic sod and mud effect.



Weathering on John Leyland's superdetailed 1/700 Yorktown includes rust stains along the sides. Note the water spilling from the pump discharges low on the ship's side.

I usually use. Another method is to underpaint the aircraft with silver, allow several days to dry, and then overpaint in the appropriate colors. Chip away the top color with a knife to reveal the silver underneath. This technique is particularly effective with larger scale models such as 1/24, because the actual chipping is visible. Don't make the mistake of flaking the paint off the black surfaces along the leading edges of wings. These areas were unpainted inflatable rubber de-icer boots.

Whatever kind of paint scuffing or chipping you do, check out the real airplane you are modeling, and try to duplicate the weathering visible on it. Remember that a little bit of silver goes an awfully long way. It is altogether too easy to get carried away with weathering effects you are creating, and overweathering is a far greater sin than underweathering. When in doubt, it is better to do too little than too much.

Aircraft also display stains and streaks caused by lubricant leaks from the engine and hydraulic systems. Such stains are caused when a small amount of grease or oil leaks from a hinge or fitting. There are a number of ways of making stains and streaks, but all involve applying a small spot of black or brown and using a moist tissue to streak it back. You can use a spot of hobby paint and wipe with thinner, or a black felt tip pen and wipe with water. The felt tip pen method has the advantage that you can wipe the streak off and try again if you don't like

the result, but the final streak should be oversprayed with a matte or gloss varnish so that it won't smudge.

Exhaust stains, when present, come in two different colors. Some are mostly black, while others have a brownish gray color; some aircraft show both at once. The gray shows most prominently on black and dark blue aircraft. When both colors are present, the stain is usually black near the source, gradually shifting to gray. These stains are best made with pastels or an airbrush. Powder residue stains from gun muzzles are common only on aircraft where the muzzles do not project from the wings or fuselage, and even then, they only extend back a few inches from their source. Similar stains may be found behind the rectangular casing ejection chutes under the wings.

Don't forget to weather the landing gear on your aircraft. Small amounts of grease and oil inevitably leak out of the gear, even on the best-maintained planes. This leakage is easily duplicated by a black or dark brown wash splashed over the entire gear, accented by a few vertical streaks applied with a brush. The strut itself is cleaned by its motion and should appear bright silver. Don't overlook the wheels on your aircraft, either. Dust and age fade black tires to dark gray, and the tire treads will almost always be dirty (look at the tires on your car). Many WWII fighters flew from natural turf fields; such planes would have mud and dirt on the wheels. Desert-based aircraft would have dusty gear

Even in the desert, in-service aircraft seldom show much dust. Airflow during flight keeps surfaces clean except for the landing gear, which is hidden from airflow in the wheel wells. Avoid the incongruity of a heavily weathered aircraft with immaculately clear plexiglass. Plexiglass scratches easily and clouds over quickly in active service. Bring the clear surfaces into line with the rest of the plane by very lightly overspraying them with matte varnish, or by polishing with fine steel wool before assembly.

Weathering steel or wooden ships.

It's a long-standing joke among sailors that they spend half their lives painting their ships. The corrosive effects of salt water and salt air on iron and steel are so severe that any ship that has been at sea more than a week starts showing rust, and after several months it becomes heavily rust streaked. Even the most scrupulously maintained luxury liner will inevitably show some rust on her hull. Look at photos to determine where rust stains are most prevalent on the ship you are modeling. Long vertical streaks on the hull are not uncommon, but they must originate from a logical source, such as an anchor hawsepope or scupper. Be careful not to overdo these streaks. A stain 6" long, enormous to a viewer standing alongside the ship, is less than 1/8" long on a 1/700 scale model.

The best way to rust steel ship models is with pastels, because the effect must be subtle, but the color must be strong. Because of the small scale of many ship models, dry-brushing often looks coarse on them. Since you can't weather a ship with pastels after it is permanently attached to the diorama (the powder will mess up your "water"), you will have to use the chalks beforehand, and handle the model with tissue until it is added to the base.

Wooden sailing ships don't rust, but they are subject to weathering of a different sort. In the days of sail, men-of-war were better maintained than merchant vessels, but all ships displayed hulls that were green below the waterline with bottom vegetation, and often their sails were stained, discolored, and heavily patched. The snow-white sails of today are the result of modern artificial fibers, but the flaxen sails of old sailing ships varied from elegant buff to dingy brownish gray, with patches of different colors depending on their ages and sources.

All of the four standard weathering techniques apply to ship models. What methods you use will depend largely on your personal preferences and the scale of the model. In smaller scales you are more likely to work with pastels, while in larger scales dry-brush, airbrush, and wash techniques are applicable.

Posing and painting figures

Figures play a pivotal role in the success of most dioramas, because as the most familiar things in the scene, they catch and direct the viewer's attention. The figures are often the visual glue that holds the scene together, the way interrelationships between the elements are firmly established. Unfortunately, badly done figures can ruin a good diorama. Nevertheless, there is no reason for the terror that painting figures seems to inspire in most modelers. Nothing is involved that anyone can't master, given patience and experience.

The most difficult thing about working with figures is that each is slightly different, so there is no precise set of steps that you can always follow to pose and paint them. Successful figure painting boils down to careful analysis of each figure, followed by the proper steps to deal with it; in fact, the vast majority of mistakes made in painting figures are mental mistakes. Figure painting is 90 percent mental and only 10 percent physical. A minimum of manual dexterity is essential, but most of the hard work is done by your eyes and mind. What I hope to do here is to

provide enough information so that you can at least avoid embarrassing yourself with your first figures, and at best produce some pretty good ones. When the techniques vary for different scales, I'll point out how.

Assembling stock figures. When you prepare figures, be especially careful to trim off all flash, molding lines, and circular molding marks. Use a sharp knife, employing a fine scraping motion to smooth over the surface. Plastic figures sometimes have sink holes in their chests caused by shrinkage during molding. These should be filled with body putty and smoothed over.

Check the fit of figure parts carefully. Make sure that hands that are supposed to be gripping something actually grip it. Watch out for sleeves. Limitations of the molding process often force manufacturers to round off the ends of the sleeves at the wrists. If necessary, cut off the hands, square the ends of the sleeves, and replace the hands. Hollowing out the sleeves slightly is also a nice touch. Watch out for the fit of headgear and equipment, examine photos of real troops wearing

the equipment, and make yours fit the same way. Once your figures are assembled, make sure you fill all seams and gaps, particularly those between the body and equipment. Plastic body putty works well for this, and can be thinned and brushed smooth with acetone or nail polish remover.

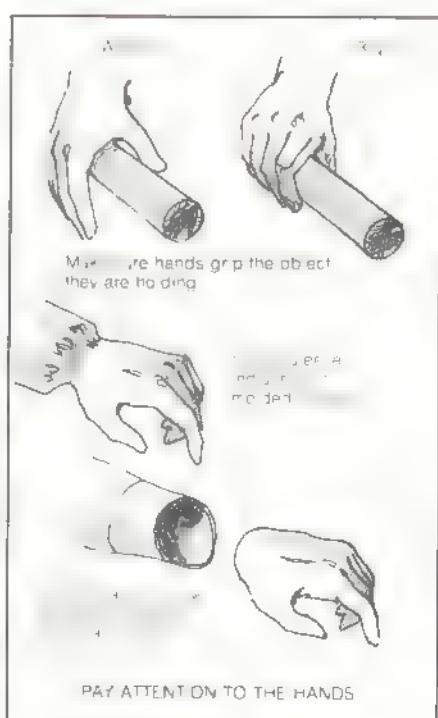
When your figures are assembled, install them in the mock-up of your diorama, both to recheck the overall design and to ensure that those intended for specific positions will actually fit there. Pay special attention to seated figures. Make sure that they sit solidly, giving an impression of weight. Sand their bottoms smooth or build them up with putty until they fit properly. I usually keep the mock-up close at hand as I work on the figures, checking frequently as I go.

Use pins to mount the figures permanently on your diorama. Glue will usually hold, but pins are more secure. Force the pin into a hole drilled in the foot of the figure, then drill a corresponding hole in the base. One pin per figure is usually enough.

Posing. The ability to pose your



Although the tank is the main subject in this scene, the charging infantrymen, not the vehicle, provide most of the feeling of drama, motion, and direction.





The 148 workers in my B-26 factory scene were converted from Monogram aircrew figures. Since "Rosie the Riveter" wore bulky clothing, the sex changes were accomplished with epoxy putty.



To reposition an arm or leg, cut almost through the joint and then gently heat the part over a candle until the area softens.



Proper working position is important in figure painting, especially detail work. Keep your wrists, hands, and fingers braced as solidly as possible.

figures frees you of the shackles of having to use commercially available poses, and vastly increases your freedom of design. Posing is very much a process of experimentation, and the major requirement is the courage to pick up the razor saw and start cutting figures apart. Even the cutting is becoming less necessary, due to the wide variety of plastic figure kits on the market. Many parts—arms, legs, heads—are interchangeable, allowing an almost infinite number of poses without doing anything more than swapping around the parts.

Effective posing is largely a matter of deciding what looks right and what doesn't. The best way to learn about posing is to have friends or relatives pose for you, or to strike poses yourself in a full-length mirror. Pay particular attention to subtleties; an extra turn of the hand, a slightly different angle for the head, or a subtle shift of balance can bring an otherwise conventional pose to life. Experiment with every figure in your diorama until you are sure that you have the best pose for each.

Avoid stiffness, particularly in relaxed poses. People at ease are round-shouldered, with the head slumped

forward. This is particularly apparent in sitting figures. Notice, too, that people rarely sit bolt upright, nor do they bend straight from the waist; the spine is almost always curved in a gentle arc from the buttocks to the nape of the neck. Standing people have a natural tendency to support their weight on one leg, leaving the other leg bent and relaxed. This throws the hip outward on the supporting side, and, assuming the legs are the same length, the hip above the bent leg must be lower than that on the straight leg. For a nude figure, rotating the hips in this manner would require cutting, filing, and re-sculpting, but in most dioramas the figure's uniform and equipment hide most of the hip area, so all we have to do is reposition the legs and return the upper body to an upright position. It is important to note that when a person carries his weight on one leg, the supporting foot is always located directly under the neck and spine. In conversions, this usually means moving the supporting leg inward until it is directly under the head.

Feet rarely point directly forward; they tend to angle outward at a natural angle of about 45 degrees. Feet pointing inward are indicative of an unnat-

ural pose or ungraceful activity, and can occasionally be used effectively for pathos or humor.

Because action poses depend less upon subtlety, they are actually easier to make than relaxed poses. There are a couple of tricks to good action posing. First, to achieve a successful impression of violent motion, throw the figure off balance. When the viewer sees a figure in a pose that couldn't be held for more than a split second without falling over, he will immediately comprehend that the figure is in motion; the more extreme the unbalance, the more violent and dramatic the implied motion. The second key to action posing is exaggeration. By carrying motion just beyond the limits of normal body extension, you create a sense of muscular imbalance. As a practical demonstration, consider the calisthenic known as the "trunk twister," in which the upper body, with arms extended, is rotated swiftly back and forth. For a split second, momentum twists the torso farther than it can normally go, then the body springs back to within normal limits of motion. For the most dramatic impact, pose the body just beyond the limits of relaxed motion, but don't cross the delicate borderline between hyper-extension and contortion.

Figure conversions. While swapping parts is an easy way to change poses, sooner or later you will come across a situation where stock figure parts don't quite fit the way you want them to. Your first figure conversions will start out as nothing more than shaving down an arm joint slightly to get a better fit, but within a few months you will find yourself performing major amputations and transplants that would horrify the most daring surgeon. There are a few things to bear in mind when you embark on radical figure surgery. First, while the human body can bend remarkably, the bones are not flexible, and they retain their original shape and length no matter what the pose. This is particularly important to remember when repositioning arms and legs. When a



These figures caught in midair are an effective (if somewhat extreme) example of the use of imbalance in posing figures to imply dramatic action.

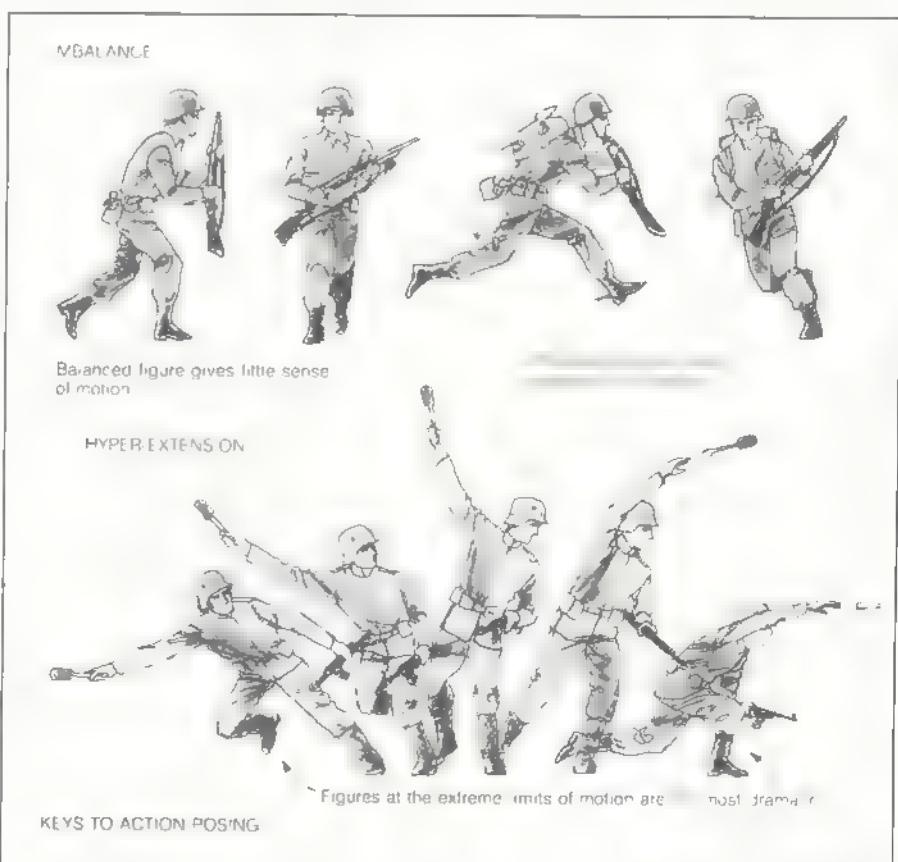
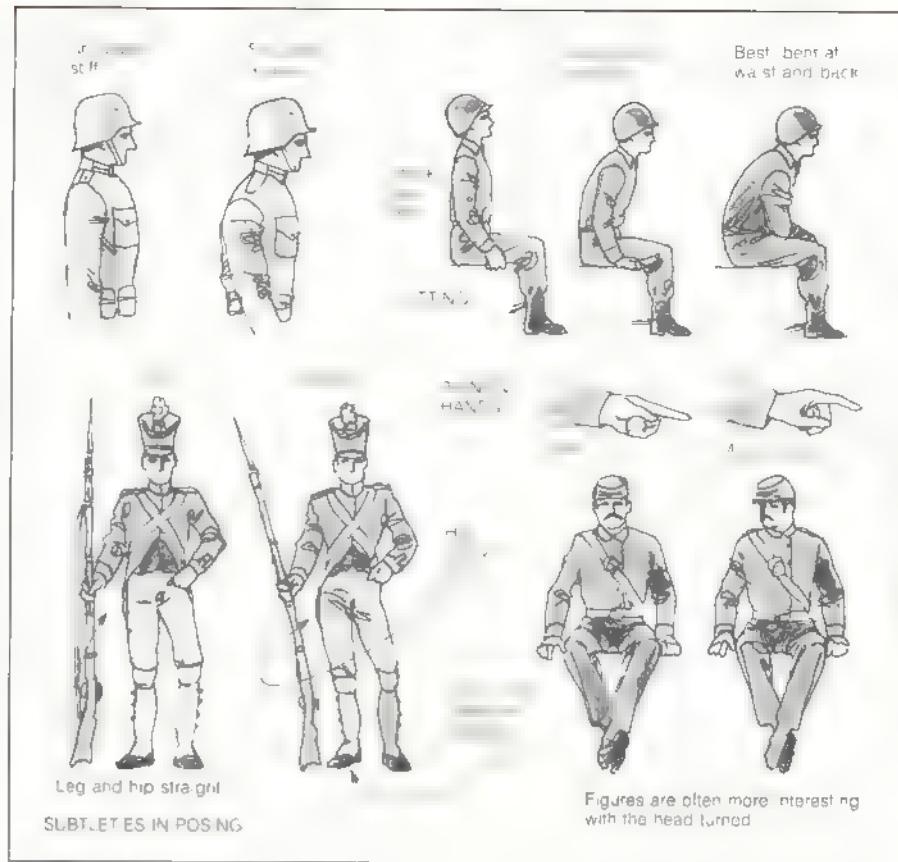
pose requires inserting scrap plastic to restore an arm or leg to its proper length, use other parts of the same type as convenient measuring devices.

The body bends at distinct joints (only the spine curves, and for model-work it can be considered to be two joints, one at the waist and the other at the base of the rib cage). This means that cuts should be made at the joints and the parts repositioned. To straighten an arm or leg, make a single saw cut from the inside of the joint, about two-thirds of the way through. Carefully heat the area over a candle or soldering iron until you can feel it give, then bend it to the desired angle. To bend a limb that is straight, remove an angled wedge, then use heat. Do not attempt major repositioning without making cuts, because using heat alone will result in "spaghetti" arms and legs. The torso can be bent forward, back, or to either side by angling the bottom of the torso piece or the top of the leg section. Which piece you cut depends on which section includes the figure's belt (change the body section without the belt). Gaps at the joints can be filled with either epoxy putty or hobby putty. Both materials can be filed and sanded when dry, but the epoxy putty has the additional property of being sealable, so minor details lost during conversion can be restored.

Many figures that are grasping things never really look as if they are holding on to the object. A man holding a 45-pound machine gun has to grip it tightly just to keep from dropping it, so the open-palmed grip provided on so many kit figures just won't do the job. Fists make excellent grasping hands; simply remove a section the size of the hand from the object being held and glue the two remaining pieces on either side of the fist. While 1/35 scale arms with fists are rare, fortunately Historex figures hands are the same size. Historex drummer's arms are available separately*, so all you have to do is cut off the drumsticks, and you're in business. When an object such as a rifle is held in both hands, the trick is to remove the hands from the arms and position them on the object first. Then arrange the figure's arms so the wrists meet the hands.

When a figure has an arm across the shoulder of another as in a walking wounded situation, the best approach is to glue the sections of that arm in position on the back of the other figure, and pose the rest of the figure to match it. Then glue the two figures together permanently and paint them as a unit.

Don't install any personal equipment or other nonessential detail on



your figure until posing is completed. Again, check the figures on your diorama mock-up—certain flaws or unnatural positions that you had not noticed before may become apparent.

When all posing is complete, your figures are ready for paint.

Scale distance, lighting, and painting positions. Although this chapter is primarily concerned with 1/35 and

* Historex spare parts including drummer's arms can be obtained from their U.S. distributor Coulter-Bennett, 12158 Hamlin St., North Hollywood, CA 91606

1/32 scale figures, the basic painting principles hold true for all scales. Paradoxically, you will find small scale figures easier to paint, because although the detail may be smaller, there is less of it. On a 1/32 scale figure the insignia on a belt buckle is clearly visible and must be painted, but in 1/72 scale, the buckle can be a dot of plain silver.

This is an example of the principle of scale distance, an important concept in all modelwork. The closest thing most of us can focus on is about 5" away; anything closer is a blur. Viewing a 1/32 scale figure from 5" away is the same as looking at a real person 12' away, and in 1/72 scale, the viewing distance approaches 40'. There is no point in including detail on a 1/32 scale figure that would not be visible on a man standing 12' away—if you can't see it in real life, you shouldn't be able to see it on a figure.

The light you paint under is important. If you find the lighting that is least flattering to your figures and paint under that, then any other viewing situation will be an improvement. Bright, diffuse light is best for painting, because it shows up all flaws in the figure and the paint. Sunlight is nearly ideal, but bright, diffuse "office-type" fluorescent light is a good deal more practical for modeling. Incandescent light bulbs rank a poor third. A few fluorescents have a strong greenish cast to them which can throw your colors off badly.

If you have trouble working at close distances, buy a binocular magnifier, the kind that has a lens for each eye. A single-lens magnifier is not good, because you need the depth perception afforded by binocular vision to judge how far your brush is from the surface of the figure.

Although the proper position for painting figures is a matter of personal comfort, the work requires a solid grip and steady hands. Rest both wrists on the edge of your worktable and hold your painting hand against the figure base. This should be enough support to keep your painting hand steady, since the only unsupported parts of your hand are the fingers. If resting your wrists on the edge of the table forces you to hunch over like a clerk in a Dickens novel, work at a higher table or raise the surface of your present bench to a more comfortable height with a box.

The first step in preparing an assembled figure for painting (always assemble the figure as much as you can before painting; if you can see it, you can paint it!) is to mount it on a temporary painting base. Use a piece of scrap wood or other material to make a convenient handle so you can paint the figure without touching it. Lightly glue or pin the figure to it. Give the

figure a coat of primer if you wish, or if required by the paint you will use.

Paints and brushes. What kind of paint should you use? Unfortunately, there are no magic ingredients. Paint is only a tool, and, like other tools, the manner in which it is used is what determines the result. A wide variety of paints has been used successfully on miniatures, and each type has inherent advantages and disadvantages. The most important characteristic of paint from the standpoint of painting figures is the time it takes the paint to set, or cure, because this is a critical factor in blending. Some paints cure as soon as they dry, while others have a certain working time after they are dry to the touch, during which they can be re-liquified and blended together right on the figure. Setting times vary not only from one base (water, oil, or lacquer) to another, but also from one brand to another.

The paint you select is a personal choice. Try them all, and then settle on the one you like best (and there is no rule saying you can't use them all!). Here are the most common types:

● **Hobby paints:** Flat-finish hobby paints thinned with mineral spirits dry fairly quickly, but most have a working time of about 24 hours before they set. Because most blending is done after the paint is dry, good results require a delicate touch. Blending often turns hobby paints glossy, their primary disadvantage. Lacquer-base hobby paints, such as Floquil, are not suited to plastic figures because the amounts of thinner used during blending will dissolve the plastic. These paints can, however, be used on metal figures where the solvent action of the thinner is not a problem.

● **Water-base paints:** These include hobby paints, poster colors, and artist's caseins. Unless they are specifically designed for plastic models, such as Polly S, they require an undercoat of matte primer so they will stick. The

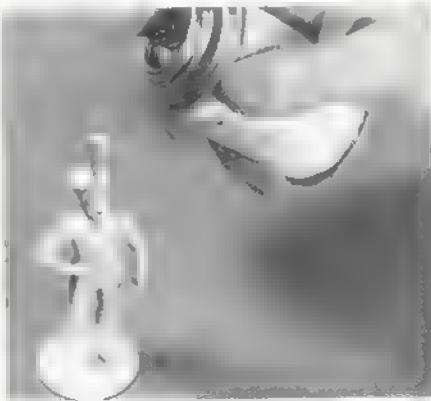
advantages of these paints are convenience, bright colors, and ease in painting fine detail. The disadvantage of water base paints is that they set as soon as they dry, leaving little time for blending. I use water paints for adding fine detail and last-minute touch-up.

● **Artist's oil colors:** Once you get over the horror of using something prepared for "artists," you may find artist's oils the easiest paints to use. I use them almost exclusively. Their greatest disadvantage is their long drying time, but this is what makes blending them so very easy. Because their consistency is different from other paints, it may take you a while to get used to them. The disadvantage of long drying time can be solved by placing the figure near a source of low heat, such as in a low-temperature oven, a box with a light bulb, or on top of the furnace. Another advantage of oils is that in the long run they are the cheapest paints to use; a starter set of small tubes can last several years, and a set of standard tubes can last a lifetime. For this reason, it pays to go first class. Buy the best oil colors you can find—they only cost a few extra cents per tube, and the quality will be reflected in your work. I recommend the Winsor-Newton brand.

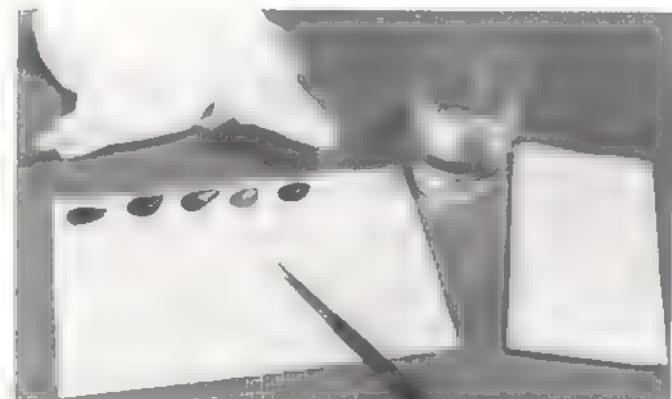
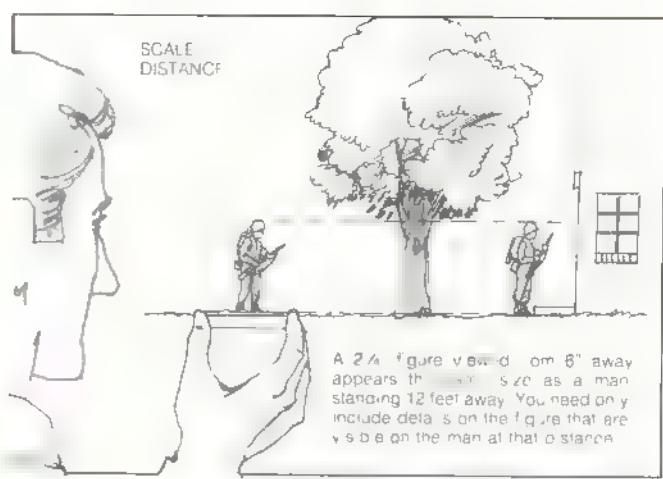
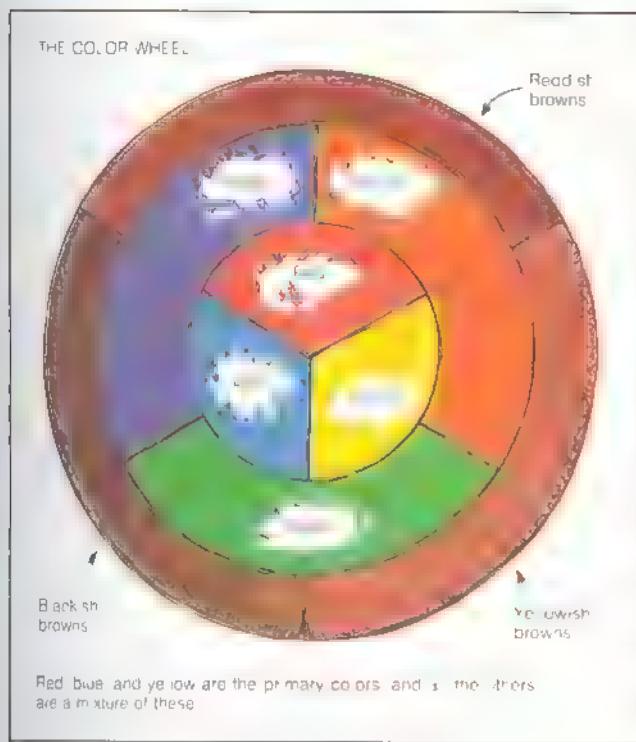
The key to all painting, figures or otherwise, is the consistency of the paint. If it is too thick it will be reluctant to leave the brush, and if it is too thin it will run all over the place. Never use any paint directly from its bottle or tube; always transfer a small amount of paint to your palette and either allow it to dry out a bit or add some thinner. Once you achieve the proper consistency, you can maintain it by occasionally adding a bit of thinner to compensate for evaporation. The right consistency for hobby and water paints is quite liquid. Artist's oils, on the other hand, should be thinner than they come from the tube, but not as thin as the hobby paints, perhaps the consistency of warm grease.

If you are painting with oils and the paint becomes gummy and difficult to blend, you may be adding too much thinner, or possibly too little. If the undercoat has a tendency to soak the oil out of the paint, giving the undercoat a swift coat of thinner before you start can help.

If the type of paint you use is not critical, the type of brush you use is. You can't make a silk purse from a sow's ear, and you can't expect to paint a masterpiece with her tail, either. For figure painting you want round red sable brushes, the best ones you can find. They are expensive, but fortunately you don't need many. One each of No. 1, 0, and 00 should be enough to get you started. The brush should hold enough paint for striping, and you will



A handy way for you to learn to visualize shadow patterns correctly is to spray paint a spare figure all the way around from above. The paint will fall in the same way as the halo of light.



This is how I arrange materials for figure painting. The folded facial tissue is for wiping the brush by stroking it back and forth (so I don't have to let go of the figure) and the crumpled tissue is for thorough cleaning. The shot glass holds clean thinner, and the white palette card is enclosed in a poly bag.

find that you can paint amazingly fine lines with the No. 0, while the vaunted No. 0000 and No. 00000 sizes hold so little paint that they are practically worthless. Always remember that what you are paying for is the point, so take good care of it and the brush will last a long time. Use your high-quality brushes only for painting figures, and wash them thoroughly in warm soapy water when you are done. Lick the bristles to a point, being careful not to twist them, and store the brushes where they will not be damaged.

Mixing colors. To paint figures well you will have to learn how to mix colors, and this entails a working knowledge of the color wheel. The basic assumption behind the color wheel is that there are three colors that cannot be made by mixing anything else, red, yellow, and blue. These are the primary colors, and all other colors are achieved by mixing these three. The primary colors form the center segments of the wheel, and each of the second ring of colors, called secondary colors, is created by mixing two of the primary colors. Blue and yellow make green, red and blue combine to make violet, and red and yellow make orange. The third ring colors are called tertiary colors. These are made using all three primary colors.

According to the color wheel, if you have the three primary colors on your shelf, you can mix any color you want. Actually, you will need two more,

black and white. When mixing, treat black as a very dark blue or brown (most black paints are) and white as an all-purpose bleaching or lightening agent. For many years I used only five colors—red, yellow, blue, black, and white—and rarely had to call on any others. The variety of colors possible using these five pigments is far beyond even the most extensive line of bottled paints.

Practice mixing some colors, and you'll find that the color wheel actually works. Try these.

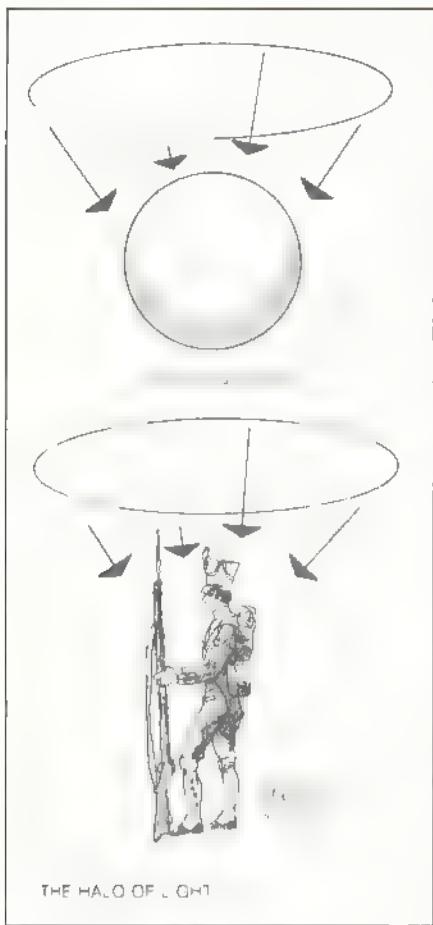
- Brown—1 part black, 1 red, 1 yellow.
- Tan—2 black, 2 yellow, 1 red, 8 white.
- Khaki—3 black, 2 yellow, 1 red, 8 white.
- Field gray—3 black, 1 blue, 1 yellow, 6 white.
- Olive green—2 black, 1 yellow.
- Olive drab—3 black, 1 yellow, 1 red.

You should have little trouble mixing any of the tertiary colors, but you may occasionally run into difficulty mixing some secondary shades, particularly purples and violets. This is because the colors you buy are rarely pure primary colors. If your red has even a bit of yellow in it, mixing it with blue is just like adding green and the result is a tertiary brown instead of a secondary purple. You probably won't need purples often, but when you do you will probably have to buy them

Aside from saving you the money and bother of having to buy a bottle or tube of every color you need, a knowledge of color mixing can also solve problems that arise in the course of painting. For example, if a face suddenly turns green during blending, you will know that the most likely cause is the accidental mixing of the blue-black in your shadow color and the yellow in your highlight, and you can adjust blending mixtures to compensate for it.

A final word about color mixing: Don't bother to clean your brush each time you dip from one color to another. This wastes an awful lot of time, and is not necessary. The amount of foreign color left by a dipping paintbrush is minuscule compared to the amount in the bottle, and the bottle will long since have been used up before this practice has any ill effect. Dip swiftly from one color to another, and don't worry about the consequences. When changing colors from red to white you can avoid the otherwise inevitable pale pink by taking a quick side trip into the blue. The blue kills the red, leaving your white clean.

You should definitely have a palette of some kind. The palette is necessary not only for mixing but also to control the consistency of the paint. For hobby paints I generally use white 4" x 6" index cards because they are disposable. For oil colors and water paints, I slip the card into a disposable clear

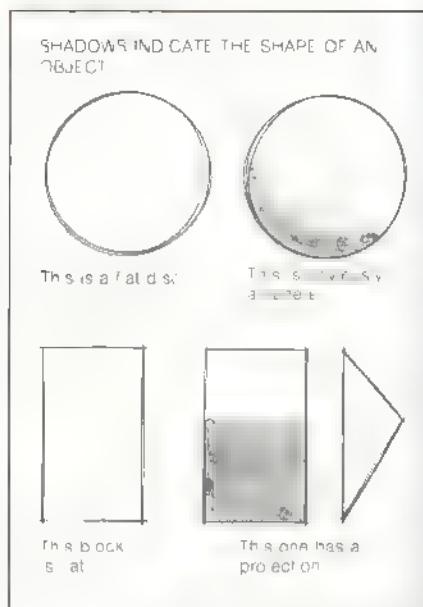


THE HALO OF LIGHT

immediate needs in a small cup, and throw it away at the end of the day's painting. A shot glass is ideal, or a rubber 35mm film canister is also good. Decanting your thinner keeps your main supply of thinner clean, and ensures that the turps you use at each session is fresh and unevaporated. Gummy turpentine can make hobby paints turn glossy. Don't worry if this small supply of thinner gets dirty—it has to get pretty badly polluted before it has any effect on the paint, and you are unlikely to manage that in just one figure painting session.

Basic painting techniques. Painting figures is a two-part process: The first part is figuring out where the colors go, and the second is putting them there. Let's start our discussion of shading and highlighting with a couple of questions: Why should we bother painting in supplementary shadows and highlights if it takes so much time and effort? Won't the room light cast its own shadows and take care of that for us? Unfortunately, the answer in both cases is "no."

If you look at a model figure painted in solid colors under normal light, the light is not intense enough to pick out the tiny shadows, and much of the detail is lost. This is because we have scaled down the figure, but not the light source. Unless we develop a special scale light source for each diorama, we must supplement the existing light with painted shadows and highlights. How do we determine where those painted shadows and highlights will go? Let's start by observing that there are two kinds of shadows: direct shadows, cast by a specific light source coming from a specific direction, and indirect shad-



ows, which are cast by no specific source, just light from somewhere up above. The difference between these shadows is essentially the difference between a sunny day and a cloudy day. For painting figures, we'll let room light cast the direct shadows, and paint in indirect shadows, because indirect shadows are what indicate an object's shape. Our eye automatically translates the patterns of light and shadow into shapes and forms. We can tell that an object is curved or bent by its shadows, even when we cannot see its shadows.

To analyze where indirect shadows will fall on a figure, imagine a halo of light about 12" above it, with the light striking the top surfaces of the figure at an angle of about 60 degrees. The

plastic sandwich bag to keep it from soaking up the paint, then throw away the bag when I am done. A piece of glass also works well, but must be cleaned after each session.

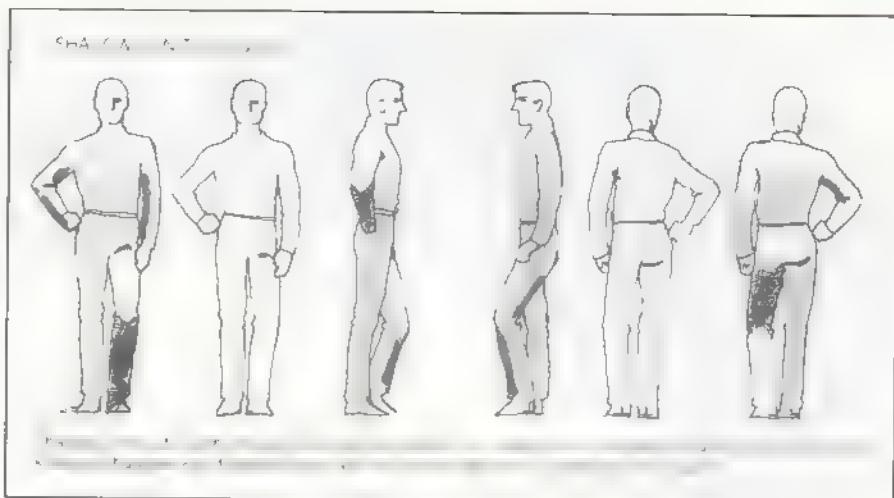
If you are working with turpentine-base paints, either oil or hobby paints, pour out only enough thinner for your



The best way to learn how to paint figures is to examine the work of other modelers, so study these examples carefully.



Only he can
see
top of the head is half a
tear
such as at the boy
than the shadow



Note how sharp, deep wrinkles have dark shadows and make rapid transitions from light to dark, while shallower wrinkles have lighter shadows and make gradual transitions. Shadows on figures are not confined only to wrinkles. Let's consider a man standing at ease with one leg bent, theoretically clad in wrinkle-free clothing. Notice that even without wrinkles, his body casts shadows that indicate his shape. The small of his back is darker than the area across the shoulders and buttocks, indicating the curvature of the spine. The lower front portion of the bent leg is darker than the upper surface, while the opposite is true of the back of the leg. When viewing from directly in front or behind, it would be impossible to tell if the leg is bent at all without these shadows.

The first step in painting, then, before you even pick up a brush, is to completely analyze the figure in this manner. Each figure will be different.

Pick up the figure and turn it around slowly, making mental notes of where the light and shadows fall. Do this twice, once for body shadows and once for clothing folds and wrinkles. The more thoroughly you think out the problems now, the fewer difficulties you will have once you start painting. Think constantly in terms of the 60 degree halo. If you are uncertain, position a light above and behind your head, and slowly rotate the figure. This provides a practical way to visualize the effect you are trying to achieve. This analysis, more than any other factor, is the key to success in painting figures. If you feel you haven't fully understood how to do it, go back and read the description again before proceeding. For your first few figures, you may have to spend as long as an hour analyzing each figure before you paint, but as you gain experience the analysis will become second nature and you'll scarcely be aware of it.





This finished pilot figure shows just how much detail and shading are possible on even a small scale figure.

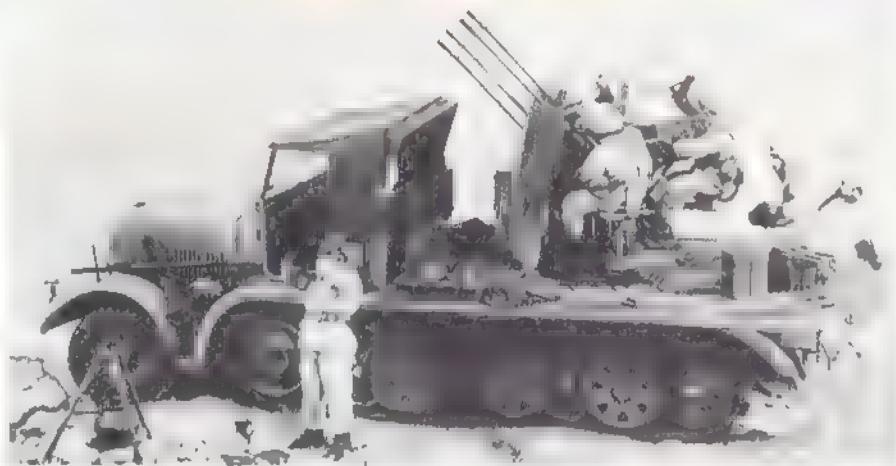
The first steps. The first step in coloring your figure is underpainting. Lay in the basic skin and clothing colors, hands, face, uniform, boots, without shading, blending, or detail. Allow this paint to set thoroughly, preferably 3 or 4 days. If you underpaint with water-base paints as I usually do, you can proceed right away since these colors set immediately and will not bleed through anything you put over them. The importance of underpainting will become clear later on when, while blending shadows and highlights, you accidentally wear through to the undercoat. The color revealed will be close to the one you are working with, and will not show.

Now you are ready to take the plunge. If you are painting with oil colors, lay out the required colors on your palette. If you are using bottled paint, mix the paints thoroughly, and arrange them, the palette, and the thinner in a convenient working pattern. You will also want to keep some tissue handy to wipe your brushes.

The traditional method of painting figures is from the skin out, doing the face and hands first, and painting successive layers of clothing in order. This is not a bad practice to follow after you have gotten your feet wet, but for your first figure, doing the uniform first gives you a chance to practice blending techniques on wide areas before moving on to the smaller and more difficult areas of the face.

The initial step in painting the uniform is to mix a basic color, a highlight color, and a shadow color. The basic color is the actual color of the uniform, the highlight is a lighter version, and the shadow is a darker version. The table provides a rough idea of how much contrast there should be among the various shades. The contrast should be strong—in fact, the

SHADING AND HIGHLIGHTING COLORS					
	Light highlight	High light	Basic color	Shadow	Deep shadow
White					
Yellow					
Red					
Olive drab					
Khaki					
Flesh					
Dark brown					



Because they have a tendency to turn gray, white uniforms are particularly difficult to paint. Well-known modeler Francois Verlinden has done an exquisite job on this five-man German flak gun crew in their winter snow-camouflage uniforms.

most common error made by beginners is color timidity. Keep your contrasts strong, even if you have to exaggerate them the first few times. You'll soon learn that blending, not the colors, gives figure shading its subtle effect.

When you have mixed your three shades, begin to carefully lay them onto your figure. This is where shading analysis pays off. Take your time, work carefully, and *think*. Each time you add a color, ask yourself why you are

putting it there. Is this area in light or shadow? Why? This process may be tedious at first, but it will soon become automatic. When you have all your colors laid in, stand back and look at your work critically. Get far enough away that the harsh borders between the colors are less distracting. Are the shadows and highlights in the right places? Is there enough contrast between the colors? It is better to make corrections now than later. When you

are satisfied, you are ready to start blending.

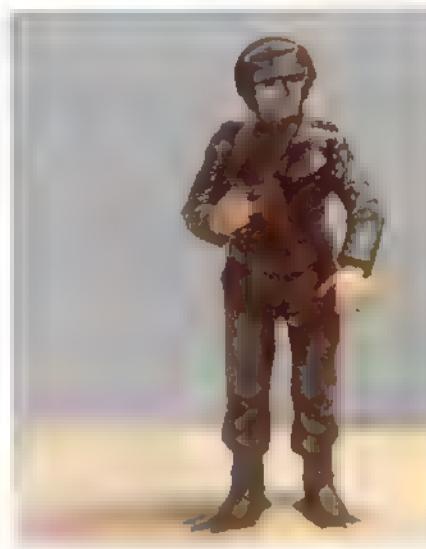
Blending. Blending is feathering the edge between two colors to get a subtle and gradual transition between them. The specific technique will vary from one type of paint to another, but a few words of advice apply to all. Always blend with the biggest brush you can. This enables you to do the job with fewer strokes, avoiding the choppy effect caused by many little strokes with a small brush. *Blend only the edge between the colors*, don't blend all the way across them or you'll wind up with just one color.

● Blending hobby paints. When working with hobby paints, most blending will be done when the paint is already dry to the touch, but before it has set. Moisten a clean, soft-bristled brush with turpentine and stroke it across a folded tissue to remove the excess. There should be only enough thinner left on the brush to soften the paint on the figure. Gently stroke back and forth across the border between the two colors until the thinner "revitalizes" the paint and the border becomes indistinct. For a smoother effect, take an occasional stroke lengthwise along the border, too. Return your brush to the thinner occasionally and clean it. If the difference between adjacent colors is radical, you may have to work in stages, blending the border first, then in turn blending its edges with the colors on either side. Again, be careful not to go too far and blend the whole thing into one solid color.

● Blending artist's oils. Artist's oil colors are easy to blend because they do not dry for a day or so, giving you plenty of time to manipulate them. Use a clean, dry brush, and gently stroke back and forth over the area to be blended, lifting the brush away from the surface at the end of each stroke. For large areas, use a crisscross pattern for a smooth effect. Wipe the brush clean occasionally on a folded tissue. The subtlety of oils is truly amazing, and even the most delicate shadings are easy with a little practice.

One characteristic of oils that takes a bit of getting used to is the heavier consistency of the paint. This will often cause a gradual buildup of paint on the figure, and you can find yourself working with a thick, gooey layer of paint, heavily textured with ugly brush marks. Attempting to correct this by thinning the paint will only cause it to dry faster and make it harder to blend. Instead, concentrate on applying a thin layer of the proper consistency and spreading the paint around a bit more.

When you have finished blending, very gently brush over the entire area with a clean, soft-bristled brush. This will soften the brush marks and add a



This sequence shows the basic steps in painting a tank commander figure. First, the face after initial blending, next, after the addition of pink and five o'clock shadow. Third, the uniform colors laid in, and finally, the finished figure, after detailing.

final touch of subtlety to the blending.

One problem you may encounter in blending either hobby paints or artist's oils is "the glossies." Sometimes the paint dries to a glossy or mottled finish in the blended areas, particularly if you have done a lot of brushwork. The solution is to overspray the figure with matte varnish. Lacking that, just repaint the area and hope for the best.

Shading light and dark. The lighter the color, the more difficult you will find it to shade. The reason for this is that the range of colors from high highlight to deep shadow is very broad, in many cases running the full gamut from almost pure white to pure black. White clothing is the most difficult of all, because the shadow colors inevitably blend over into the highlights, turning snow white to dingy gray. The keys to shading white clothing are, first, to not over-shade it, and second, to touch up the highlight areas after the shadows have set. Although the

shadow colors you use will range all the way to a dark gray, the majority of your areas should remain white. Remember that the overall color impression of the figure will be the average of all the colors used to shade it. When painting and shading white, remember that white uniforms are actually a very pale shade of some other color, usually gray or brown. Avoid using straight black when you shade whites. The ultimate (and rather shameful) answer to the problem of white uniforms is to avoid them whenever you can, particularly when you are just starting out.

Other light uniforms, such as khaki, are not as difficult to shade as white, but the range of shading colors is still a little intimidating. With most light colors other than white you have enough leeway that if the shadow color creeps into your highlight, it will not be too noticeable.

Dark colors are quite easy to shade;



When you complete a figure, examine it critically. A handy trick is to use a mirror. Because your eyes are not accustomed to the mirror image, you will often spot flaws that you overlooked.

the trick is to avoid overshading them. The impression of the figure when viewed from a distance should still be that of a dark color, not black. Since the base color is already pretty dark, it will not be too different from the shadow (usually jet black), so blending should be easy. Be sparing in your highlights to avoid lightening the overall color. One modest highlight shade should be enough, because dark colors often pick up sufficient highlights from room lighting alone. Black is the easiest color of all to shade because there are no shadows (there being no color darker than black), and only the faintest highlights. If you want easy uniforms to paint, stick to panzer black!

When blending is completed, step back and examine your work. Is there still enough contrast in the colors? Have you blended too much away? Now look more closely. Is the blending smooth, with a gradual shift of color, or are there rough spots? Do the folds look natural? Have you shaded the body shape as well as the folds? Have you highlighted the top of the folds? A common mistake is to highlight the projecting parts of the fold and shade the depressions when actually, the top of the fold should be highlighted, and the underside in shadow.

Go back and correct any flaws you have noticed. To restore lost contrast you can go back and add more color, but bear in mind that you will have to use lighter highlights and darker shadow tones to compensate for colors already on the figure, and that each additional layer will increase the buildup of paint on the surface. If the accumulation of paint becomes too great, you can sometimes wipe off the excess carefully

PAINTING EYES



The eye is more of a wedge shape than an oval. The colored iris is barely in contact with the lower lid, and partly covered by the upper lid.



THE CROSS METHOD FOR PAINTING EYES

If you have trouble positioning eyes on the face, this should help.



1 Do not paint any whites at all in the eyes at the normal viewing distance. The whites appear the same color as the face.



2 Paint a wide band of gray blue or brown through each eye socket keeping each band the same distance from the nose.



3 Paint a narrow band of black or dark brown down the center.



4 Cut off the top of each eye band with a dark brown line. This is the upper eyelash. Concentrate on positioning the bottom edge of this line correctly keeping the two eyes level from side to side and let the rest of the line fall where it may.



5 Add half of a bottom lash.



6 Carefully trim the eye down to size with flesh-colored paint.

with a cotton swab or rolled tissue and start again.

Faces and hands. The face is the most challenging, most frustrating, and the most satisfying part of painting a figure. The job that you do on faces will, more than any other factor, establish your ability as a figure painter.

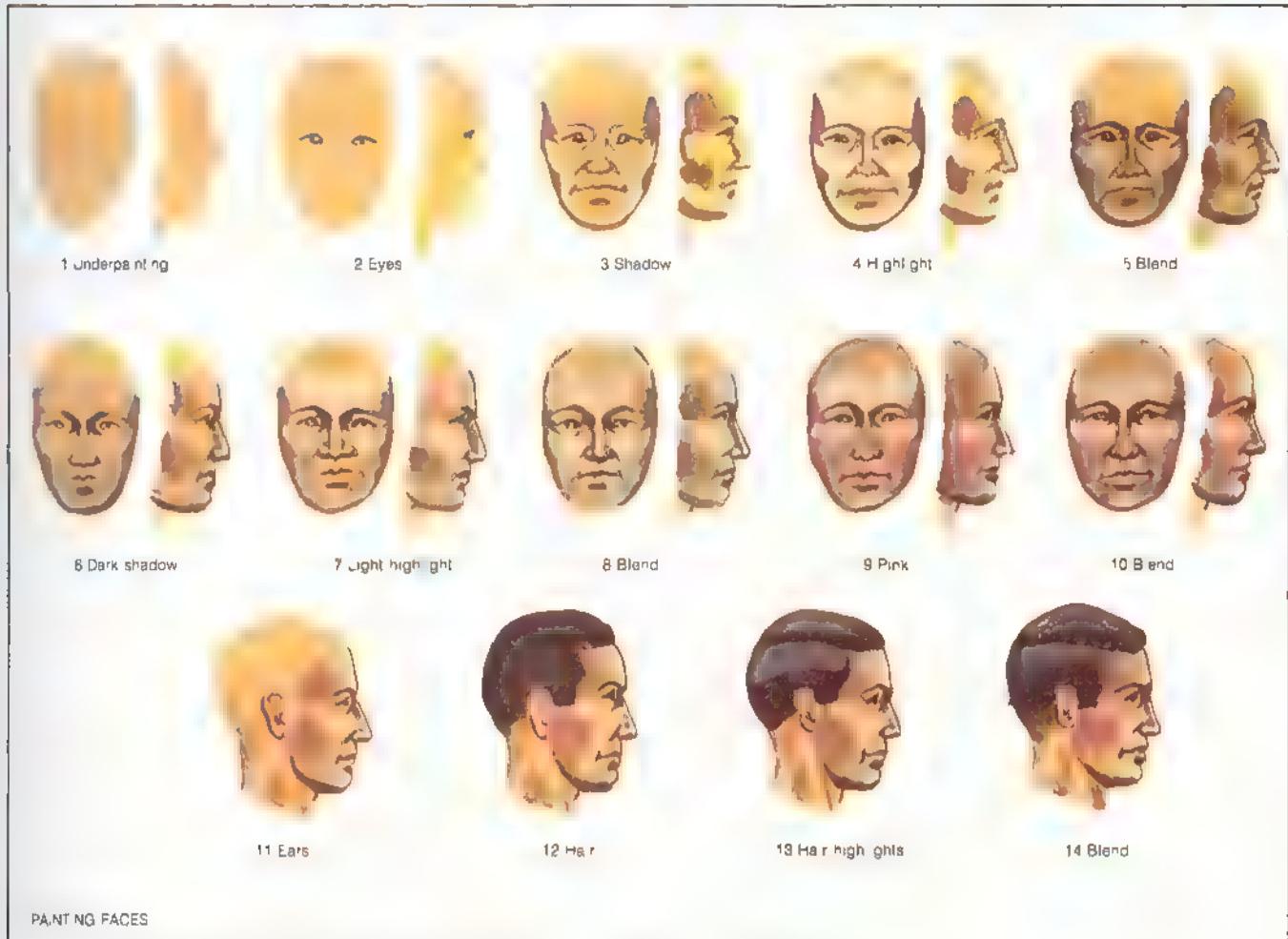
I usually paint eyes at the same time and with the same paint as my undercoat, so that the eyes will not accidentally get blended into the rest of the face. Our main concerns in painting eyes are to make them straight, the same size, and symmetrically located in the face.

Most diorama scenes are set outdoors, where men tend to squint in the sunlight. This makes their eyes little more than slits, even in 1/32 scale. Also, in all common modeling scales the whites of the eyes are not white at all, but essentially the same color as the rest of the face. This is an instance of scale distance in which the tiny blood vessels blend in with the white of

the eye to make it appear pink. Painting pure whites in the eyes is the major cause of the notorious "popeyed look" that every modeler wants to avoid.

If you have trouble painting and positioning eyes, the drawing shows a technique that should help. It's called the "cross" technique and it allows you to separate the problems and concentrate on them one at a time. The last drawing shows the finished eye. Notice that there are no lower eyelashes (they are not visible at a normal scale viewing distance) and the lower edge of the eye cuts straight across. Contrary to popular belief, eyes are not almond shaped.

Now we turn to the face itself. Let's start by looking at the face in terms of the 60 degree angle of light rule. The deepest and consequently the darkest part of the face is the area between the eyes and under the brows, on either side of the nose. Somewhat less dark will be the underside of the chin, under the nose, and under the upper and lower lips. The highlights fall across



P A I N T I N G F A C E S

the forehead, down the bridge of the nose, on the cheekbones, and on the point of the jaw. These shadow and highlight areas are the keys that establish the shape of the face.

One of the biggest difficulties in painting faces is that there is so much to do in such a small area. In 1/35 scale, your entire working area is about the size of a large pea. For this reason it is not generally a good idea to lay in the full range of colors at once. Blending in such a small area is bound to result in a few colors getting lost in the shuffle, so you are better off to block in only the basic color, highlight, and shadow. Blend these first, then go on to lighter highlights and deeper shadows in a second stage.

The first step is to mix three basic flesh colors. Stay away from commercial "flesh"; it is invariably too pink. Remember that soldiers are out in the sun a lot, and their skin is tanned and weatherbeaten. What we are looking for is a sort of pinkish tan that is best achieved by mixing yellow ochre (yellow brown), burnt sienna (red brown), and white. Add some of this mixture to white for highlight and some to burnt sienna for shadow.

Now lay these colors onto the face. A No. 0 or 00 brush is as small as you should need for this job, don't go any

smaller. Use the step-by-step pictures as a guide, and when you are done, step back far enough for the distance to do some blending and examine your work. Now clean your brush thoroughly and start to blend. Use short, delicate strokes. In such a small area it is especially important to restrict your blending just to the borders between colors. It is alarmingly easy to blend too wide an area, and this is where most of your problems are likely to set in.

When the blending is done to your satisfaction, mix up a darker shadow and a lighter highlight. The highlight should be almost pure white, and the shadow a dark brown. Carefully lay these colors in as shown in the drawing and blend them carefully. You are now working with really tiny areas of color, so the blending calls for an exceptionally delicate touch. Just whisper the brush across the surface, using something of a stabbing, stippling motion to avoid disturbing other colors nearby. Be particularly careful that your high highlight and deep shadow colors never meet. The highlight contains a lot of white and the shadow a lot of black, and if these two meet they will turn the face gray.

The final step is to add a touch of pink to the cheeks and lips. Use a

darkish pink and apply a dash below each cheekbone and to the upper surface of the lower lip. Blend the cheek areas until just a subtle hint of the color remains. You probably won't have to blend the lip much at all, but do add a light pink highlight in the center.

A common touch for combat soldier figures is a 5 o'clock shadow. This effect is not too difficult (if you have gotten this far, you're ready for anything!), just mix up a gray or grayish brown and apply it only to the shadow areas in the beard area. Blend this color in, feathering it lightly across the highlights. This will turn the highlight areas slightly gray without changing their essential color.

Moustaches and other hair should be painted last. The real trick to painting and shading hair is to treat it not as a group of individual strands, but as a solid mass. Analyze the hair as a single shape in terms of the 60 degree angle of light rule and go to work. Highlight the upper surfaces of locks and waves and shadow the undersides. If your figure has brown hair, avoid highlighting with a rich chestnut brown, since human hair rarely grows that color. Instead, use a standard brown for the basic color, and add white for the highlight. Remember,



The face is the most important part of any figure painting effort. While a good face can often save a mediocre figure, a poor face can ruin an otherwise good one.



Once you master the basics of painting faces, strive to give each figure character. Each of these faces has a personality that brings it to life.

too, that blond hair is not really yellow, but more of a tan color, even in its palest forms

Hands are painted with the same colors used for the face. The darkest shadows go between the fingers; be sure to feather them lightly to either side, simulating roundness. Use lighter shadow on the underside of the hand (depending upon which side is up) and across the fingers below each set of knuckles. Fingernails can be added with a drop of highlight color at the end of each finger, left unblended. Be sure your figure's hands are not too smooth. Men's hands tend to be rough and muscular, with veins showing prominently on the back of hand. Mottle the color on the back of the hand to indicate the muscles, and add veins with the highlight color

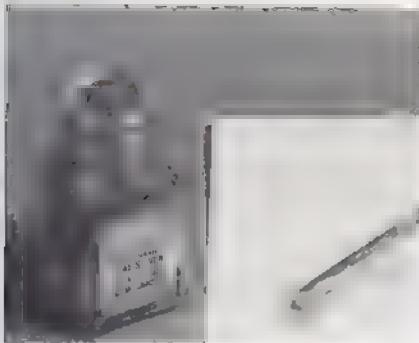
Painting detail. When painting uniforms, I start with the widest areas and gradually work my way down to the

smaller ones, saving the fine detail for last. As you work your way down in size, the blending becomes progressively easier. If you are working in oils, don't feel that you are limited to working with only one color per session for fear of bleeding. Oils tend to stay where they are put, and you should be able to paint adjoining areas with no problems. Although it is usually best to wait until the first color is dry, it is sometimes possible to overpaint oils while the color underneath is still wet.

The two keys to good detail work are the consistency of the paint and a good steady grip on the figure and the brush. These have already been mentioned, but they are particularly important in detail painting. If your grip is not steady, your hand will shake and you won't put the paint where you want it. If the consistency of the paint is not just right, it will not flow, or flow too freely, both of which can ruin fine

detail. Proper control of the paint is 90 percent of fine detail work. With it, detailing can actually be fun, but without it, detailing is the very height of frustration

Scale distance is an important principle in detail painting. A lot of modelers try to paint in details that would never be visible at all at the scale distance they are working with. This is losing sight of the forest for the trees. Don't try to paint individual feathers on an eagle so small that they would never have been visible anyway. Concentrate instead on getting the head, chest, wings, and legs properly proportioned and readily identifiable. If the figure has a complicated piece of embroidery such as twisted-cord shoulder boards, don't try to paint each cord and twist. Instead, break the shoulder boards down into a characteristic pattern of lights and darks, then duplicate that pattern on the figure.



Never stir metallic paints. Instead, transfer a small amount of the thick goop at the bottom of the bottle to a card, then add liquid from the top of the bottle until the consistency is what you want.

This is an old trick copped from the great masters of oil painting. Look closely at an elaborately detailed helmet in a Rembrandt painting and you'll discover that all it really is is a collection of carefully designed squiggles. The moral of this tale is that you will get a lot farther by suggesting detail than trying to duplicate it point for point.

For leather gear and other shiny objects, don't make the mistake of using a high gloss paint unless the material is patent leather. You can achieve a more realistic subtle sheen by mixing glossy and matte paints together, or by applying gloss or semigloss varnish over the matte colors. Polly S makes an excellent water-base gloss finish that won't disturb colors underneath it. One coat gives a soft, almost imperceptible, shine while additional coats gradually yield a high gloss. Bear in mind that gloss decreases in intensity as it is miniaturized; a high polish in real life becomes merely semigloss in miniature, even on the parade ground. The leather gear of troops in the field is rarely polished, and usually has no shine at all.

Some detail painting will involve metallic colors. These touches add final sparkle to your work, and there are a few things you should know about using metallics. Metallic paints are nothing more than fine metallic powder suspended in a clear paint vehicle. The finer the powder, the better suited it is to modelwork.

There is one cardinal rule in working with bottled metallic paints: NEVER stir the paint. To do so is to lose control of the consistency of the paint, which is the key to painting detail. Instead of stirring, transfer pigment from the bottom of the bottle to your palette, then add liquid or let it dry until the paint is the proper consistency. This will help you avoid the classic problem of applying a neat drop of silver to a button only to have it run across the uniform.



These 1/18 scale figures from "The Gun Deck of HMS Victory" (page 85) show how facial expressions add drama both to the individual figure and to the whole scene.

Buttons present no problem, but occasionally you'll encounter metallic areas that require shading. Weapons are easy as long as the engraved detail is good and crisp—paint the metal areas black and dry-brush over them with gunmetal and silver. For areas where this is not feasible, shade metallics the same way you would shade the uniform. Add black to your silver or brown to your gold for the shadow color, and use straight metallic for highlight. Block them in on the figure and shade and blend as usual. The slightly different characteristics of the metallics may cause some initial difficulty, but you'll get used to it quickly.

Don't assume that everything on a uniform is bright silver or gold. Metallic braid and lace do not have the same glitter and shine as smooth metal buttons, and even buttons are sometimes frosted. To achieve a dull metallic effect, paint the area with ordinary colors, and shade and blend them as usual. When they have set, go over them with a light wash of metallic paint to add the right amount of flash and sparkle.

When working with metallic paints, be careful that they do not pollute your other colors. A small amount of metallic is all it takes to do this, and once the damage is done, it is irreversible. Never use thinner that has been used for metallics for any other paint, and clean your brushes especially carefully when you are done. Many painters keep a separate set of brushes for metallics.

Before leaving the subject of figures, I'll add a word about a somewhat distasteful subject. If your dioramas are military scenes, sooner or later you will encounter a situation that calls for blood. The way you handle this small detail can make or break the scene, and far too many modelers overdo it. Unless shocking your viewer is your main intention, a little bit of blood goes a long way. Gory splotches of bright red paint all over your diorama quickly mark you as a tasteless amateur. A few well-placed drops are not only more discreet, but considerably more effective in the long run. Blood runs from wounds in fine ribbons, not broad bands of red, and it is rarely bright red. The best way to paint blood is to paint it first in crimson and then highlight with red. Then add high-gloss varnish to make the paint look wet.

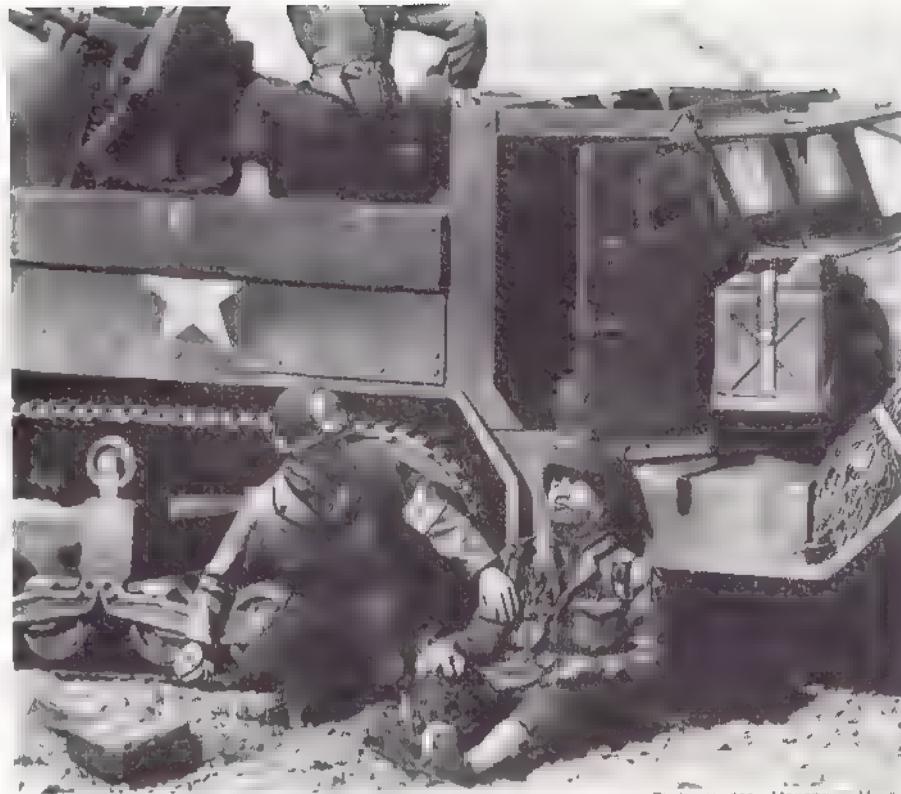
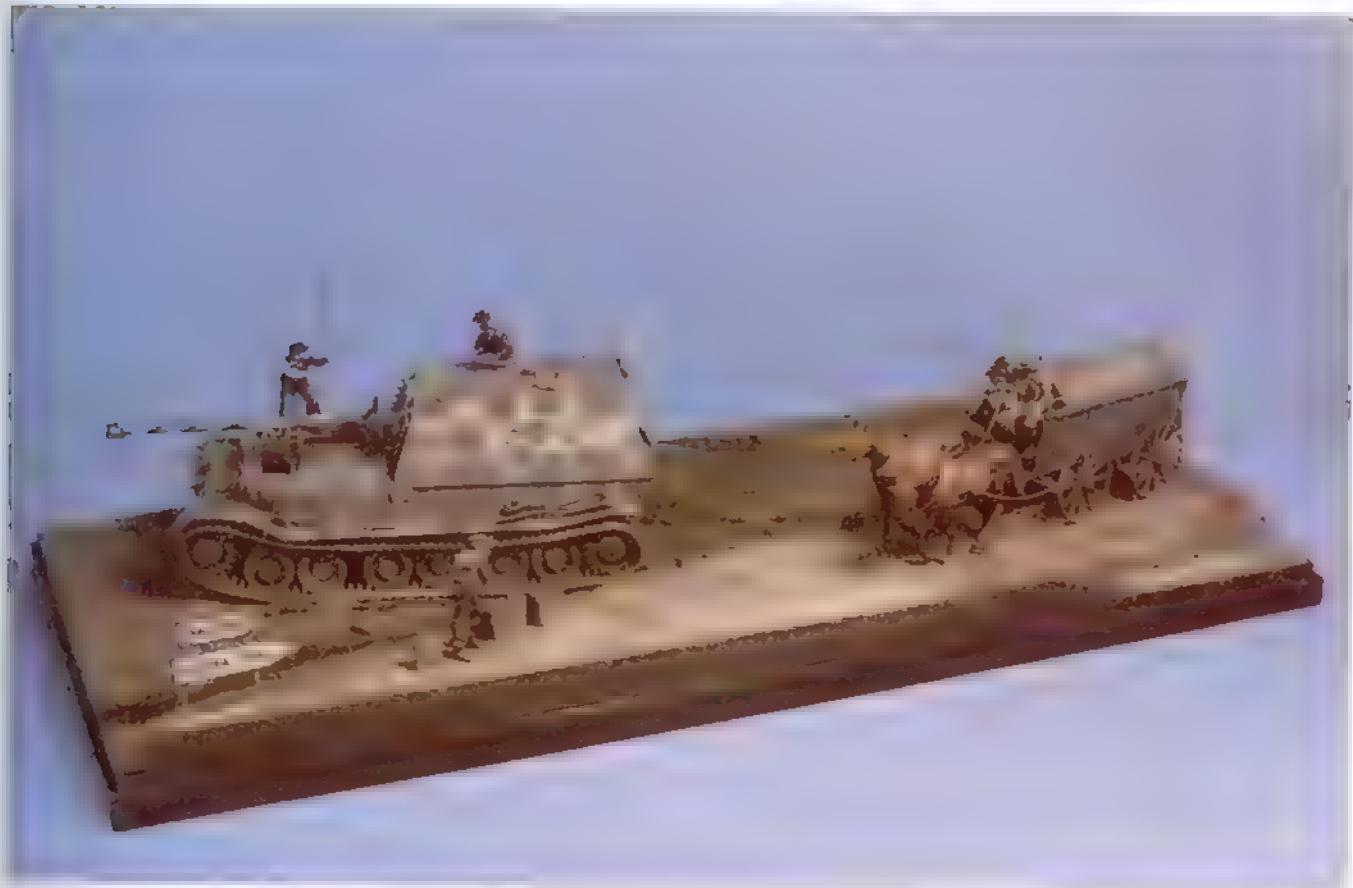


Photo courtesy Monogram Model

Blood must be handled with taste. The trooper on the ground in this scene is gravely wounded, but the amount of gore has been kept to a realistic minimum.



If you include bodies in a scene, make sure they look dead, not just knocked over. Be sure to press them firmly into the groundwork. Note the way this figure's head is thrown back, and how the helmet tilts down over the eyes.



6 Step-by-step

The Elefant's dilemma

This whimsical diorama is a "delayed reaction piece"; it takes the viewer a moment or two to realize what's going on. Interestingly enough, the idea did not start out to be humorous at all. It started out during a bull session with friends about an intersection scene, with a harried MP trying to sort out a traffic jam. Two of the vehicles were to be a jagdpanzer Elefant and a horse-drawn supply wagon. While discussing subplots, the idea of having the Elefant run out of gas came up. The intersection and the rest of the vehicles were quickly forgotten, and the disgruntled tanker flagging down the wagon became the focal point of the scene.

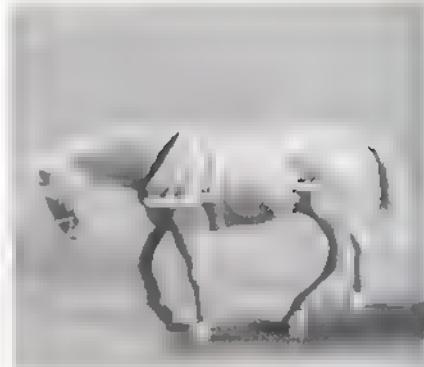
Both models in the scene are 1/35 kits: an Italaeri Elefant and an Esci supply wagon. Both are beautifully detailed and require little or no modification.

Here's the visual key to the Elefant's dilemma—a hapless German tanker with an array of four bone-dry gasoline cans.

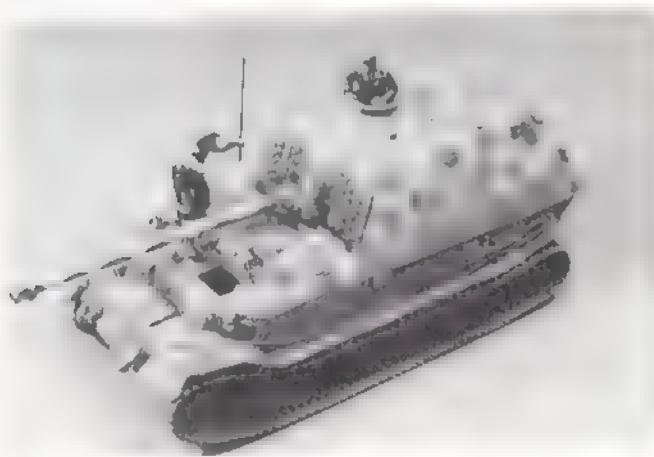




The initial planning stage: the kits have been assembled and the figures posed. A couple of pieces of scrap lumber simulate the raised roadway. Even in the mock-up stage it's easy to see how the figures direct the viewer's eye around the scene.



The wagon was built with no modifications at all, partly because it is such a nice kit and partly because I had no reference to check it against. One of the horses was modified by lowering the neck, to give it a stolid, "dobbin" look. The gap in the neck was filled with epoxy putty.



The only modifications made to the Elefant were replacement of the tow cables with ones made of solder wire, application of Zimmerit, and the addition of periscopes in the driver's hatch.



Zimmerit is an optional modification. The figures are pinned through the feet and glued to the vehicle with white glue so that they can be soaked loose if necessary.



After the base dimensions were established, the raised roadbed was added. It is a strip of plywood covered with veneer on the ends. The edge of the road was beveled and nicked.



The groundwork applied to the base. The path of the Elefant was made using the model, and the ruts in the road were made with a toy car. Although it doesn't look bad in this photo, the overall effect with the vehicles in place was quite disappointing. The ground looked too "manicured," and there was a vast empty space in the upper right corner. Even though the Celluclay was hard, I was able to soften it with water, scrape off the offending sections, and re-landscape it (lower photo). The culvert is a piece of brass tube and the muddy water in the ditch is the painted and varnished base. Now the groundwork is not as smooth as before, and the ditch fills the dead space and adds interest to the scene.





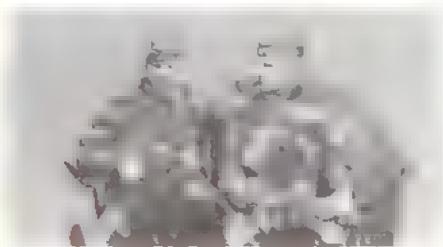
A view of the wagon, showing how the reins fit the hands of the driver. The reins are paper, stained brown before installation and coated with white glue once in place. The rope traces are twisted solder wire. The hooks molded on the horse harness for the chain (I used ship model chain) and traces are inconvenient to work with, so I drilled holes and inserted wire hooks.



The road sign was provided in the supply wagon kit. It establishes the locale as Italy, where most of the second model Elefants saw service. The wood grain was wiped on using a brown wash, then the lettering was applied with dry transfers. Final weathering was accomplished with pastels.



A back view of the finished diorama. The rusty color of the culvert stands out against the green water and foliage, making the pipe and ditch an excellent space filler.



The other figures in the scene were converted from various Tamiya tank crew and infantry figure sets. This conversion work was so much a matter of trial and error that there is no way I could tell you which parts were used for which figure. Additional details, such as shoulder straps and pocket flaps, were made from epoxy putty.

The wagon figures were used as they came in the kit, although the rifle was removed from one and an epoxy loaf of bread—more appropriate for a field bakery unit—was substituted.



Details and accessories

Details and accessories not only add interest to a diorama, they also fulfill the mundane but necessary function of filling space. You will often select a detail not because of what it is, but because you need an item of a particular size to fill dead space and balance your scene.

What kind of details can we use? For aircraft, the possibilities are pretty much limited to ground support and maintenance equipment, including work platforms, service units, bomb carts, tow tractors, wheel chocks, fire extinguishers, and aircraft parts. For armor, the range is more varied, and useful items include bedrolls, ammo boxes, ration cases, storage lockers, vehicular equipment, discarded weap-

ons, and other battlefield debris. Small structures and terrain features such as wells, water fountains, roadside shrines, signposts, telegraph poles, fences, walls, and hedges are also useful.

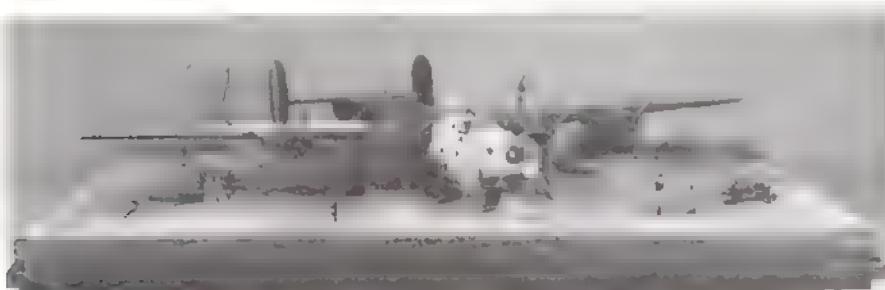
There is a wide variety of ready-to-use accessories available, with the promise of still more to come. Several companies offer plastic and metal accessory kits. Ready-to-use accessories can also be found in modeling hobbies using the same scale, an important source that is often overlooked. Armor enthusiasts will find metal accessories offered for model soldiers that will serve well for armor dioramas. A major resource for aircraft modelers is the model railroad field

Model railroad "O" scale is actually 1/48, and many accessories are available that can be used on aircraft dioramas. "HO" scale is by far the most popular model railroading scale and the variety of accessories available is wondrous. HO scale is actually 1:87, a bit small for 1/72 aircraft and 1/76 armor, but you will find an awful lot of HO parts that can be used to detail dioramas. Take the time to browse through a good model railroad shop to see what is available. Wm. K. Walthers Inc. of Milwaukee is one of the largest model railroad suppliers and its catalogs are excellent home references. Walthers publishes illustrated catalogs for both HO and O scale.

Creative scavenging. "Creative scavenging"—looking for likely items in areas outside normal hobby sources—is one of the best ways to find detail parts and accessories. Wherever you go—the hardware store, the toy store, the florist's, *anywhere*—be on the lookout for useful detail pieces. In some cases you may not know what a part might be used for when you first see it, but if you file it away for future reference, either physically (if it's cheap) or mentally (if it's not), months later you may find a use for it. Such creative scavenging is a challenge to your ingenuity.

Other sources for accessories are the hobbies of radio control and miniature rooms. The workmanship on many items in these areas is often too coarse for application to smaller models, but every so often you'll find something worthwhile. It's always worth browsing through these areas at your hobby shop.

Tarps, blankets, and bedrolls. Some of the easiest details to make from scratch are rolled tarps, blankets, and sleeping bags. These are made from tissue paper, and you'll need little or no practice before you can turn them out by the dozen. Start with a piece of facial tissue (don't use toilet paper, it dissolves in water), about 2" by 4", dip it in water, and fold the two long sides into the center. Now, starting at one end, carefully roll the strip up and tie it with thread where the straps will go. Use long pieces and cut off the excess when you are done. Paper or card straps can be added later when the



A B-24 spotted on an open hardstand leaves a lot of space around it to be filled, and accessories are a good way to hold viewer interest and create an impression of activity.



Ingenuity is important in creating accessories. This water pump was built from the pipe from a bazooka, the base from a truck transmission, and the handle and swivel posts from a 60mm mortar. The concrete base and wooden trough were made from sheet styrene.



If you work in 1/48 scale or smaller, model railroad parts such as these are extremely useful for detailing all kinds of diorama scenes.



Steps in making bedrolls or tarps, left to right: wet tissue, tissue folded toward center, then rolled and tied. The photo below shows how a tissue-paper tarp looks after painting.



piece is dry. The tissue rolls can be painted by first giving each roll a quick coat of thinner to ensure proper coverage and eliminate white spots. When the paint is thoroughly dry, dry-brush as usual and use white glue to hold the rolls in place on the vehicle or diorama.

Tissue paper is excellent for duplicating all kinds of cloth: tarpaulins, discarded clothing, even drapery on figures. Wet tissue folds just like real cloth, and the secret to using tissue realistically is realizing that thin cloth such as a cotton shirt will have many more folds than thick cloth such as a heavy blanket. Use additional layers of tissue to simulate thicker material; as many as ten plies of tissue may be required to duplicate a thick blanket or heavy overcoat. When using multiple layers, it is best to layer the tissues, cut out a rough shape, wet carefully, and then cut to the exact shape.

Drape your tarp, discarded jacket, or blanket in position, carefully arranging the folds with a toothpick or paintbrush. Use extra tissue to soak off excess moisture and then brush on a heavy coat of white glue. After this

initial glue coat has dried, brush on more glue to eliminate the telltale texture of the tissue, then paint.

Simple scratchbuilding. In spite of the variety of commercially available accessories, sooner or later you'll find yourself faced with the requirement to scratchbuild something special that you need. The mere mention of the word "scratchbuilding" is enough to start shivers down the spine of many modelers. It shouldn't be. Scratchbuilding doesn't always have to mean building an airfield control tower complete with full interior and working lights; it can be as simple as making bedrolls out of tissue paper. If you've never scratchbuilt anything, start with small projects and gradually work your way up to more ambitious ones. Knowing how to build things from scratch opens up many diorama subjects that would otherwise be beyond your ability.

One of the first steps in becoming a competent scratchbuilder is to learn how to use *all* the materials available to you. I emphasize "all" because some modelers work exclusively with one or two materials, ignoring others. This is



This diorama of a B-26 assembly line makes use of nearly all the materials and techniques discussed in this chapter. The factory effect is greatly enhanced by mirrors placed on each side of the scene. The mirrors generate the illusion of an assembly line that extends as far as the eye can see.

a severely restrictive approach that often results in unnecessary work. Each material—styrene, wood, brass, and epoxy—has its own strengths and weaknesses; each is more suitable for some jobs than others, and each is easy to use once you know a few simple tricks of the trade.

Working with sheet styrene. Although most modelers have built plastic models, few have scratchbuilt with sheet styrene. Sheet styrene plastic is usually white. It is commonly available in thicknesses of ten (.010"), twenty (.020"), thirty (.030"), and forty (.040") thousandths of an inch. Five (.005") and sixty (.060") thousandths are also available. Evergreen Scale Models makes styrene strips and scribed sheets. Small strips are not particularly useful unless you need a lot of them, since you can easily cut your own, but thicker pieces, up to $\frac{1}{4}$ " square, are useful and can save a lot of time that would be spent laminating thinner stock. Plastruct offers a line of ABS sheet and structural shapes which is compatible with styrene if you use Plastruct's special Plastic Weld cement.



To cut sheet styrene, scribe a groove in one side and snap the sheet by bending with both hands.

Sheet styrene is easy to cut and cement, and thin stock is flexible enough to make curved surfaces. It can be sanded and polished smooth, carved easily with a knife, and permanently formed by the application of moderate heat. Its disadvantages are that thin sections not supported from behind will warp, and sections thicker than the standard sheets must be laminated or constructed hollow. Small, delicate fabrications such as antennas are very fragile.

Cutting styrene is easy. Using a straightedge as a guide, scribe the surface once or twice with a knife and snap the pieces apart. Even curves can be cut in this manner. Thicker sheets may require two or more passes with the knife. Thin sheets may be cut with scissors or a paper cutter, and holes punched with a paper punch; styrene strips can be cut with flush-cutting nippers. Styrene can be sanded using fine sandpaper wrapped around a small block of wood, and cosmetic emery boards also come in handy.

Styrene, like the plastic in kits, is cemented with solvents that dissolve the plastic and form permanent welds. Methyl ethyl ketone and ethylene dichloride are the best solvents; they can be purchased by the pint or quart from plastics supply houses or industrial chemical distributors. Liquid

plastic cements sold for plastic models also work well. Many of these solvents evaporate too fast to be used like other glues. Instead, the procedure is to align the two pieces to be glued and carefully touch a brush full of solvent to the seam. Capillary action will carry the solvent down the length of the seam, and the bond will be almost instantaneous. Both simple and more complex box shapes can be easily assembled in this manner. Simple curves are made by cementing thin sheet to curved back braces.

Styrene can be glued to other materials with 5-minute epoxy or alpha cyanoacrylate (ACC) "super glue." Do not use white glue or other adhesives meant for porous surfaces such as wood; the bond may hold momentarily, but it will soon give way.

The simplest technique for heat-forming styrene is stretching sprue to make plastic rod and wire. This is done by holding a piece of scrap runner frame over a candle or other heat source until soft, then stretching it to the desired thickness. Stretching very hot plastic yields hair-thin "wire," excellent for aircraft antennas; letting the plastic cool a second or two before stretching makes thicker plastic rod.

Another simple heat-forming method is to wrap styrene strip around metal tubing or a wood block. The styrene is held in place with rubber bands or clamps and immersed in boiling water for 5 or 10 seconds. This is a fast and easy method for making plastic rings, rectangular frames, and straps. Complicated shapes can be heat-formed by carving male and female dies out of wood, clamping a piece of styrene between them, and immersing the sandwich in hot water until the die halves come together. A low-temperature oven is a good substitute for boiling water, although water is more convenient.

A more sophisticated heat-forming technique is vacuum-forming. This involves heating a sheet of plastic until

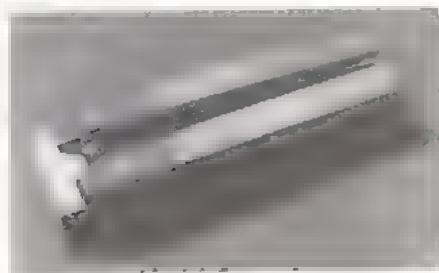
it is flexible, laying it over a wooden form, and using a vacuum pump to pull the rubbery plastic down tight against the form. A toy vacuum former was made years ago by Mattel; it was perfect for modelwork, but has been off the market for some time. A company called Idea Development makes an assemble-it-yourself machine that works off a home vacuum cleaner.

Because it has no grain, styrene is best suited for modeling metal, but it is also useful for modeling wood, particularly heavily weathered wood. Wood grain detail can be scribed into the surface with a scribe or knife. Scratchbuilt styrene parts can be painted with any model paint suitable for plastic kits.

Scratchbuilding with wood. In this age of plastic, there is a tendency for modelers to overlook the classic modeling medium, wood. Wood is an excellent choice when the job calls for a lot of strip material in a variety of thicknesses and sizes, or when the thickness of walls or other features would make construction in plastic awkward. Wood is easily cut, sanded, and finished, and can even be curved slightly. Its disadvantages include visible grain (which can either be used to advantage or eliminated) and lack of strength in thin sections.

Several woods are suitable for modeling: old favorites include birch, pine, basswood, apple, cherry, boxwood, and pear. Stay away from open-grained woods such as oak, walnut, or mahogany for very small work. Balsa is excellent for flying model aircraft where weight is an important consideration, but it is too soft and flimsy for precision miniature work.

Basswood is probably the best all-around wood for modelbuilding, and it is readily available in hobby shops in a large variety of sizes and shapes. Strip basswood sizes range from $1/32$ " square to $3/4$ " square, and structural shapes and various thicknesses of sheet wood, both plain and scribed, are



This arrangement of a formed basswood block, styrene strips, and two clamp-type clothespins will be immersed briefly in boiling water to heat-form a carrier frame for a jerry can.



To de-fuzz stripwood, first spray with a fast-drying clear lacquer, then rub with fine steel wool.

also offered. Plywood is also useful. Most hobby shops stock special plywood for model planes and boats. This comes in a variety of thicknesses, and is excellent for structure walls and other applications that call for thick material. If you are building something that calls for a large quantity of structural shapes, such shapes are a lot cheaper in wood than they are in plastic, particularly in the larger sizes.

The first step in working with wood is to eliminate its natural fuzz. Even if you can't see it, sawing fuzz is there and will become visible as soon as you paint the wood. Spray all wood parts with fast-drying clear lacquer to raise the grain. When this is dry, give each piece a quick rubdown with fine steel wool. This treatment provides a smooth surface for painting, staining, or varnishing, but leaves the wood sufficiently porous to be cemented with standard wood glues.

Wood can be cut with a razor saw, knife, flush-cutting nippers, or even scissors. A simple miter box for cutting 45- and 90-degree angles is useful. Ordinary white glue such as Elmer's is more than adequate for joining wood parts. I also use an aliphatic resin glue called Wilhold. Epoxy will also work well on wood (useful when gluing wood to plastic or metal) but standard super glues will not, since they are designed for nonporous surfaces. There are cyanoacrylate adhesives (super glues) designed for wood now on the market, and these are excellent. Hot Stuff, Jet, and Zap are brands sold in hobby shops.

Working with wood can proceed almost as fast, sometimes faster, as working with plastic. The glue dries rapidly in small applications, and precutting stripwood parts can make even the most complicated assembly go together very quickly. A set of clamps, either screw or sliding wedge type, is useful but not essential. Wood can be painted with any standard modeling paint—oil-, water-, or lacquer-base.

No special preparation or priming is necessary. Wood can be stained for a variety of interesting and attractive effects. Stains accent the grain of the wood beautifully, and there are some excellent "weatherbeaten" stains available in the model railroad field. Most glues are stain-resistant; staining the model after assembly will leave ugly glue marks at all of the joints, no matter how carefully you work. This problem is easily avoided by staining all parts before assembly.

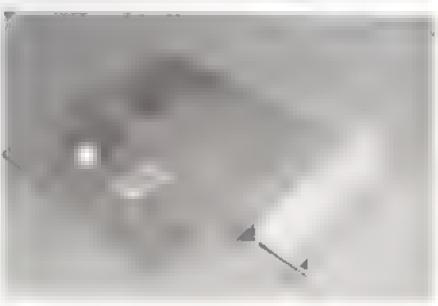
Working with brass. Brass is the ideal material to use when a structure calls for a framework with many curves and bends, or when you must build a delicate assembly with a lot of strength such as a "crow's foot" antenna. Brass is a relatively soft metal, and can be cut with saws, tin snips, or clippers. It can be sanded or filed smooth, and takes a high polish. Brass wire can be *annealed* (made softer and more flexible) by heating it with a propane torch until it glows dull red and then allowing it to cool.

Brass can be glued with super glue or epoxy, but no glued joint will ever approach the strength of a soldered one. Miniature soldering is not difficult once you learn the basic principles. The first principle is that solder will stick *only* to those parts of the metal that have been cleaned and prepared with flux. Excess solder will ball up on a fluxed area instead of flowing to any unfluxed portion of the work. The second principle is that *both* pieces being soldered must be heated to the flowing temperature of the solder for the process to work. It is the heat in the joint, not in the solder, that makes the solder flow and provides a strong bond. If you are soldering big pieces, it may take a while to heat them up even if the area of the joint is small. If you have difficulty soldering, it is probably because you have failed to observe one of these two principles.

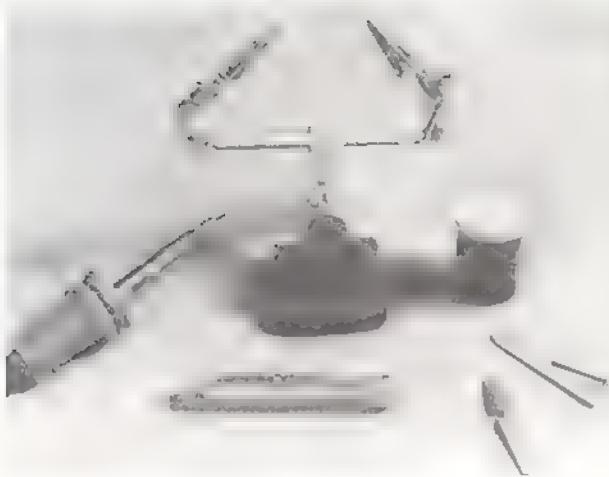
The tools you'll need for soldering are quite inexpensive. You'll need a

soldering iron, preferably one with replaceable tips. Any type of 60/40 tin-lead solder is fine, although the small-diameter solder sold for electronics work is best. You will also need flux; the best kinds are acid-base liquids or pastes. Don't try to use cored solders that include flux in the solder wire. These are convenient for electrical work, but too sloppy for modeling. You can use cored solder as ordinary solder without any problem, but don't count on the core for fluxing. To heat the work to the proper temperature without burning your fingers, you'll need something to hold the pieces in position while you work.

Miniature soldering is different from electrical work. Here, the neatness of the joint is important, so you need precise control over the amount of solder applied. Plug in your soldering iron, and while you are waiting for it to heat up, put your pieces in the fixture and align them. When your work is positioned and the iron is hot, brush a small amount of flux into the joint. Then cut off a small bit of the solder, just enough to do the job, and pick it up with the tip of the iron. In order to get the solder to stick, you may have to clean the tip of the iron by filing or scraping away the oxide. If this doesn't work, dip only the tip of the iron into the flux. Carry the little ball of solder



Two useful tools for working with wood strips are NorthWest Short Line's "Chopper" cutting tool and a small miter box to be used with a razor saw.



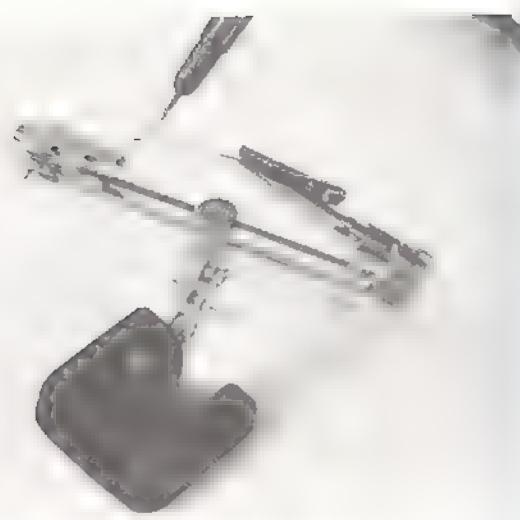
The basic tools and materials for soldering, from left to right: soldering iron, solder, "extra hands" soldering aid, flux, and a couple of aluminum heat sink clips.

to the work and touch it to the joint. Let the heat flow from the iron through the solder to the work. When the parts reach the right temperature, the solder will suddenly flow into the joint. Pull the iron away, and the job is done. Allow the joint to cool naturally, because hastening the cooling can weaken the joint. In small joints the solder cools in seconds, and with a bit of practice you will find that you can solder almost as fast as you can glue.

Soldering large pieces or multiple joints is more challenging. Large pieces call for more heat, so you may find it easier to solder heavy brass parts with a torch. The standard Bernz-o-Matic propane torch sold in hardware stores will do. It may be a bit clumsy at first, but keep the torch on the lowest setting and it will work quite well. The trouble with multiple joints is that heat applied to one joint may melt the one you just finished. This problem is cured by the use of heat sinks, small metal clamps placed between the joint that is already

soldered and the one that is about to be. The heat sink draws off enough heat to prevent the previous joint from melting.

Working with epoxy putty. Epoxy putty is ideal for jobs calling for detailed shapes or compound curves that would be awkward to carve in wood or plastic. It is excellent for making vacuum-form patterns, seat cushions, parachute packs, duffle bags, knapsacks, and figure conversions. This is a material few hobbyists are familiar with, since it is not commonly sold in hobby shops. It is a two-part epoxy material that comes in sticks that are kneaded together to form a putty with the consistency and workability of modeling clay. Its primary uses are sealing automotive pipes and body work. A plumber's or automotive supply house is where you are most likely to find it (Brookstone Company, Peterborough, New Hampshire, sells it by mail). Since it is not formulated specifically for modeling, each brand has a little different consistency. One

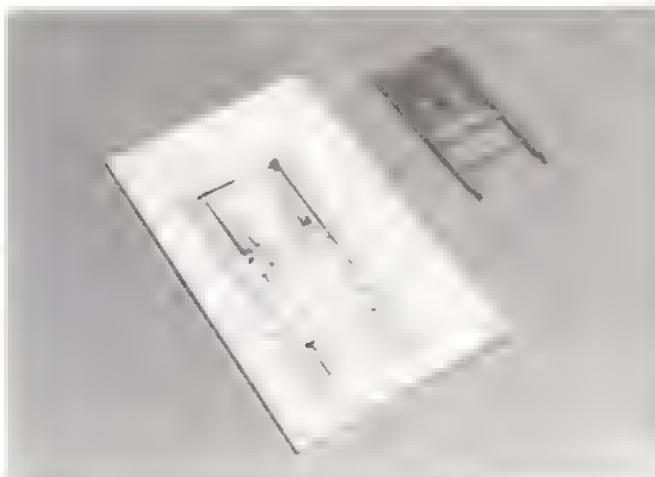


Here is the soldering aid in use while making a delicate "crow's foot" radio antenna assembly from wire.

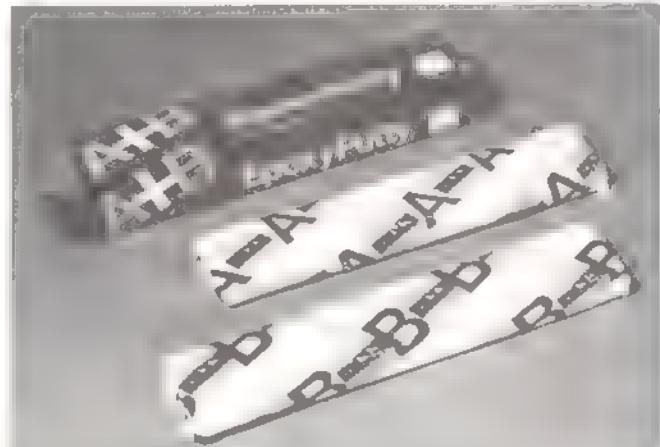
brand, Duro E-pox-e Ribbon, is widely available in dime stores.

Epoxy putty holds the shape it is molded into, and sets in about 2 hours. Applying low heat can reduce the setting time to about 15 minutes. The putty is water soluble, sticks to itself quite well, and can be made even stickier by the application of a little water. Putty work is best done in stages: make the basic shape, and when the first part has cured, apply a little water to the hardened epoxy and add the new detail. The hardened putty can be filed, sanded, machined, carved, sawed, and even polished with fine steel wool.

Boxes, crates, and tubes. Let's put all this newfound knowledge to work by scratchbuilding some simple boxes and crates. It makes no difference whether you use wood or plastic. The drawing shows the basic assembly procedure. Note how the binding pieces at each end of the box are cut longer than necessary, glued on overlapping one another, and trimmed to

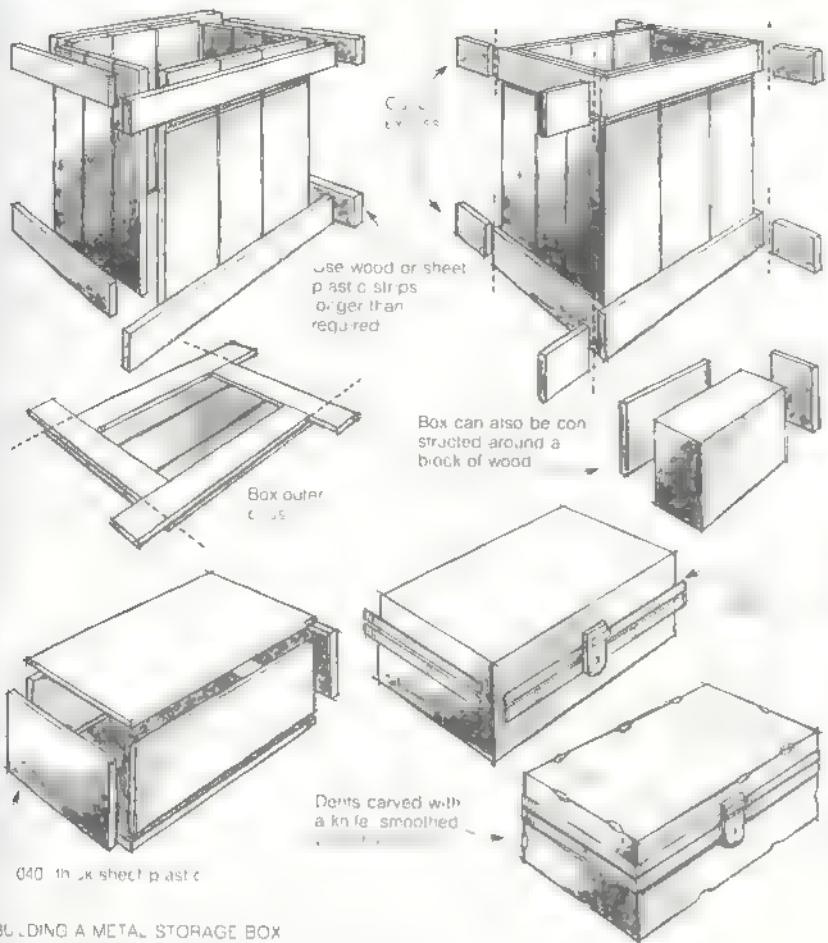


The wood and cardboard jig at left was specially made for soldering the ornate chairback at right.

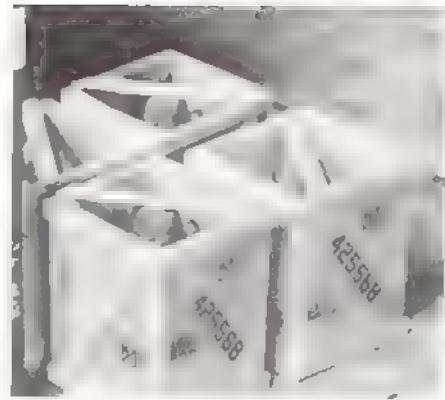


This A & B Epoxy Putty, made by the Biggs Company of El Segundo, California, is the brand I use. There are several other suitable brands on the market.

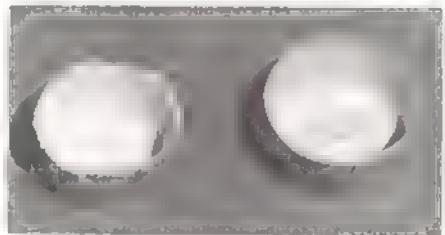
BUILDING A CRATE



BUILDING A METAL STORAGE BOX



Little touches like the stenciled lettering (taken from aircraft decal sheets) on these wood crates are what make the difference between average dioramas and really good ones.



The individual wood slats of these wash-tubs were rough cut from wood strips and assembled (left). Then, after the glue had dried completely, the entire tub was sanded to size (right).

size after the glue has dried. This simple principle is worth repeating: *Never cut anything to exact size if it can be glued in place oversize and trimmed to size later.* This little trick will give your work the appearance of precision craftsmanship without any of the bother.

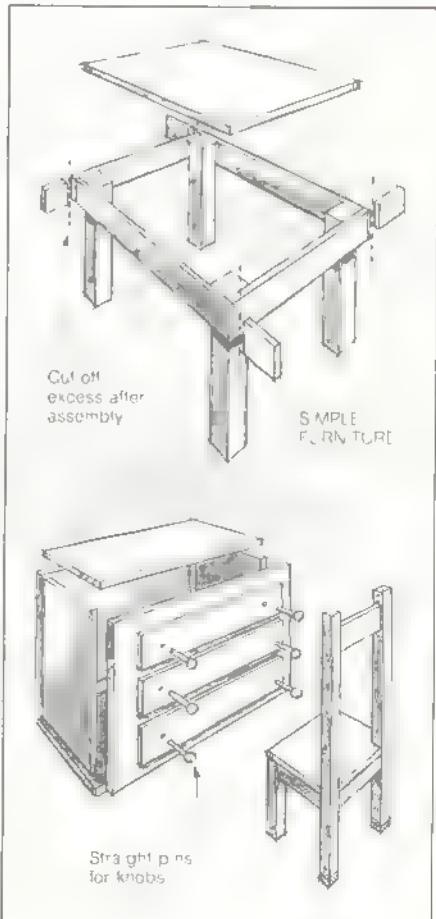
Metal toolboxes can be made from sheet styrene. Add handles and other hardware with wire and bits of plastic. Since metal boxes are pretty flimsy, add a few nicks and dents with a knife, file, or Dremel tool, and round off the edges of the box by rubbing with fine steel wool.

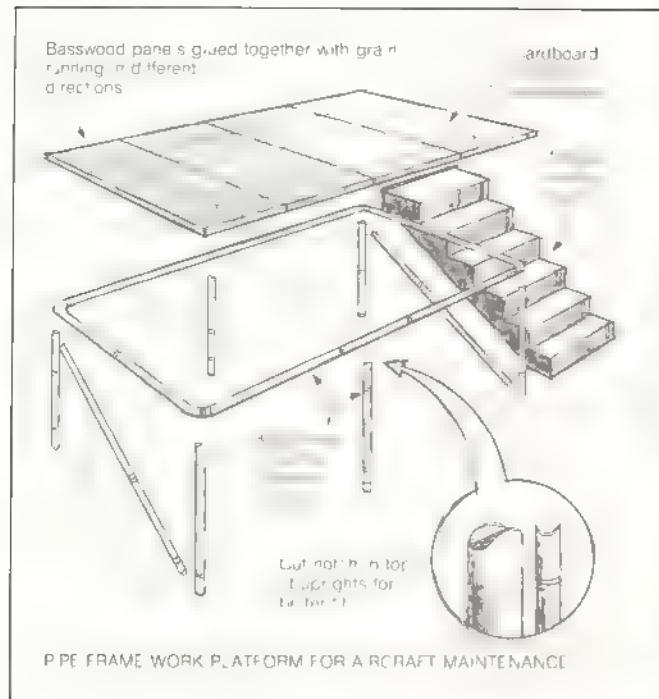
Furniture and work platforms. Simple furniture can be made in much the same way as crates. The drawing shows some workable designs that can be thrown together quickly when nothing elaborate is required. Workstands are an important part of aircraft maintenance scenes, and are not hard to make. The real stands are usually made of light steel pipe, formed structural steel, or a combination of the two. Dig into your research library to see just what the work platform you require looks like. It was not uncommon for field units to whip

up special items of their own in their welding shops.

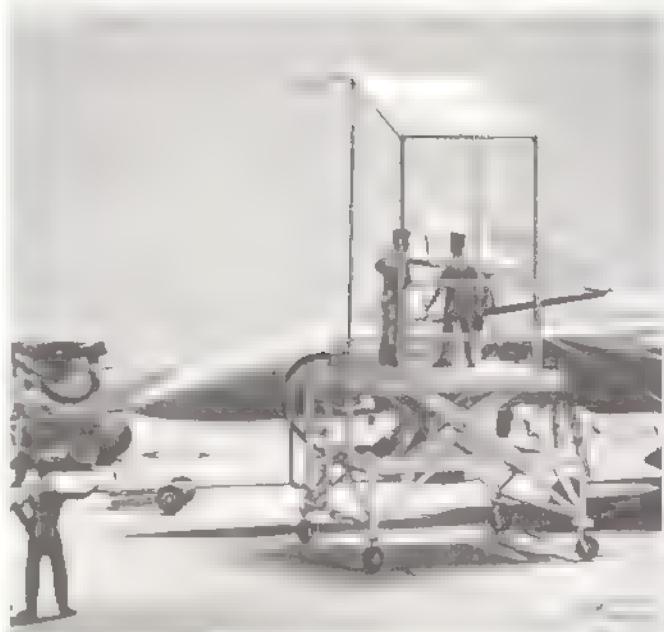
The simplest workstand is a pipe frame. This can be made out of brass wire, soldered together. Most modern workstands have nonskid metal flooring, but it is not unusual to see plain plywood sheets bolted to the pipe frame. If you choose to simulate plywood, don't make the sheets bigger than a scale 4' x 8'. Safety tread metal flooring is easily duplicated by rubbing a piece of aluminum foil over a piece of fine wire screen with a pencil eraser. Miniature brass screen is sold in hardware stores as "furnace mesh." The textured aluminum foil is then glued to a plastic sheet, painted, and—presto—safety tread!

More complicated work platforms and ground-support equipment require more effort and planning, but essentially use the same techniques. The engine hoist shown in the drawing is a typical example—the hardest part of building one is figuring out how it fits together and what kit parts can be used. Most workstands, particularly standard issue, had wheels. Tail wheels from 1/72 or 1/144 aircraft work pretty well in 1/48 scale, until you





PIPE FRAME WORK PLATFORM FOR AIRCRAFT MAINTENANCE



This modern aircraft workstand includes a sunshade and an adjustable hydraulic jacking mechanism.

realize that each platform calls for at least four of them! Airliner wheels from 1/144 scale models offer a less-expensive alternative, since each kit contains many of them, but even this is not a real solution to the problem. When you need many identical parts, one way to obtain them is to cast them yourself.

Casting your own parts. Casting is a technique that is indispensable to professional modelmakers, and with the proper materials, it is not difficult at all. The first thing you need is a pattern. This can be an original kit

part, a modified kit part, or something you have made up yourself. If the item you need is a complex assembly, you may have to break it down into several parts for casting.

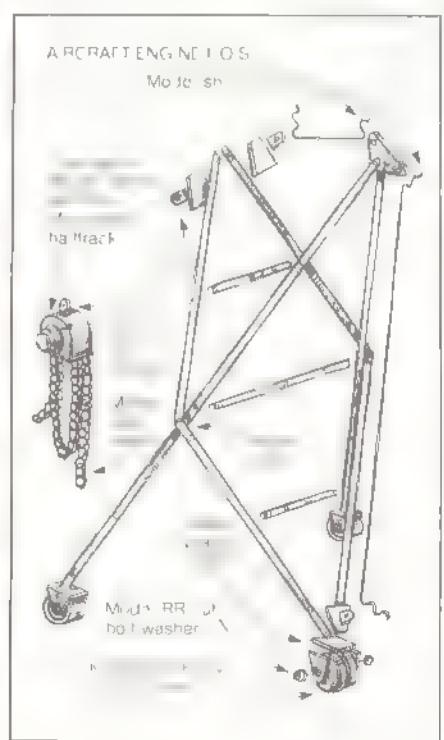
The mold is made from RTV (room-temperature vulcanizing) rubber. The major manufacturers are General Electric and Dow Corning. There are many types; the material you want is the kind that requires no special scales for mixing, will cure against any pattern material, and is of sufficiently low viscosity to form an air-bubble-free mold without the use of a vacuum

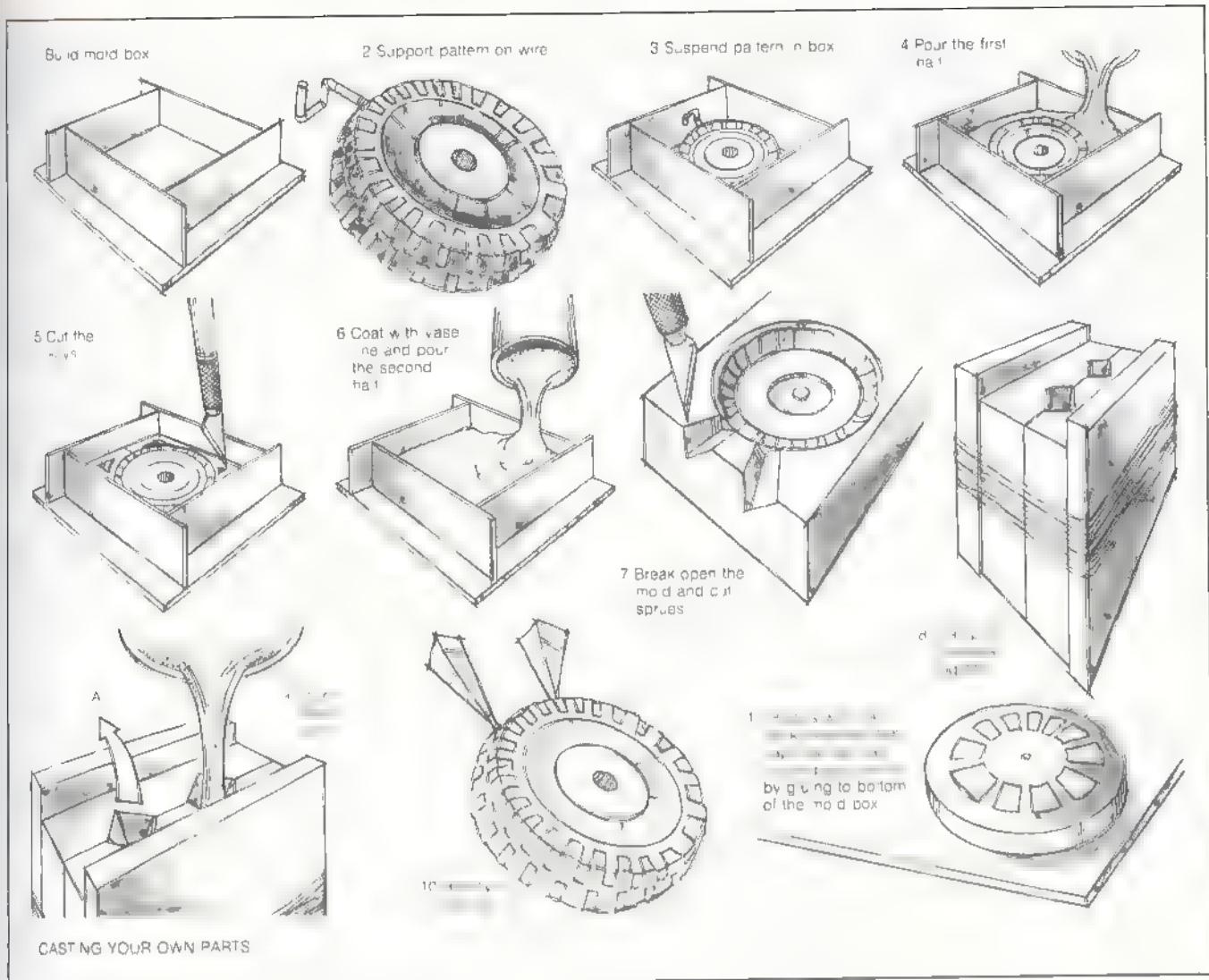
system. The GE rubber I use is RTV 11, which comes in one pound containers and includes a small tube of catalyst. The mixing proportions for the catalyst are not critical; the more catalyst you add, the faster the material cures. Low, humid heat can also speed curing, which normally takes from 4 to 24 hours.

Successful castings can be made from plaster, but the material I use is a 50-50 mixture of polyester resins. The two ingredients are Tuf-fil, a thick polyester patching material that is included for its fast setting time, and



The workstands on the B-25 assembly line are made of brass wire, soldered together. The air hose hanging limply from the overhead is shaped solder, and the air wrench is a model railroad part in disguise.





CASTING YOUR OWN PARTS

the clear polyester resin used for modeling water, to thin the mixture. For hardener, I use the cream hardener supplied with the Tuf-fil. Five-minute epoxy glue can be used to make small detail castings, but they will be a bit

rubbery and sticky when first pulled from the mold.

The first step is to build a mold box. This serves only as a dike to hold the liquid rubber until it cures, so even a crude wall of modeling clay will do.

The usual material for the box is wood or styrene, and the box should be large enough to surround the pattern with about $\frac{1}{2}$ " to spare on three sides, 1" on the fourth.

Support the pattern on a piece of



A pattern, in this case a wheel, supported by wire in a simple home-built sheet styrene mold box.



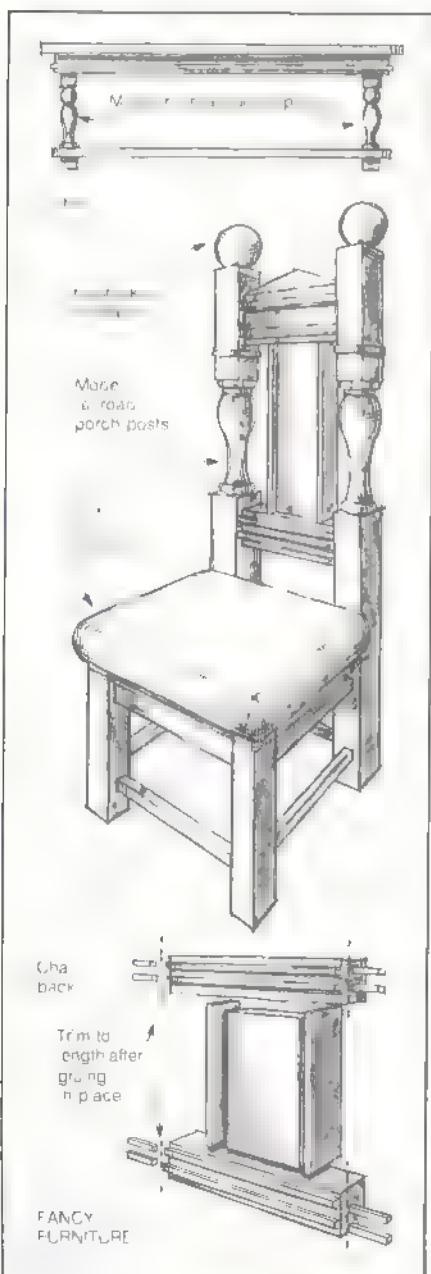
Casting materials, clockwise from left: Tuf-fil, mixing cup, polyester resin, mold, scrap wood wafers to hold the mold together, and a sample casting. Tuf-fil is available from Freeman Manufacturing Co., 1152 E. Broadway, Toledo, Ohio 43605.



The shell of this electrical substation on my B-26 factory diorama is sheet styrene edged with Plastruct ABS structural shapes. It is detailed entirely with diesel locomotive parts, and total construction time was less than half an hour.



This air compressor for the B-24 polka dot painting scene (page 50) started out as an HO scale tractor model. The seat and large wheels were removed, and a simple ABS (Plastruct) frame and railroad air tanks added. The air hose is soldered.



bent brass wire. Insert the wire in a hole drilled in the side of the pattern, and glue the bent part of the wire to the side of the box with super glue, leaving the pattern suspended in midair in the center of the box.

Mix up the RTV as directed and pour it slowly into one corner of the mold box until the rubber level is halfway up the side of the pattern. When the rubber has cured, use a sharp knife to cut a chunk of rubber from each corner. When the second half is poured, these recesses will form locking keys to keep the halves in proper alignment.

Coat the first half of the mold with a thin layer of Vaseline, and pour the second half. When the second half has cured, break open the mold, remove the pattern, and cut pouring sprues into the thick end of the mold. Cut two sprues, one to pour in the resin, the other a vent to allow the air to escape as the mold fills. Make the pouring sprue as large as possible.

Sandwich the mold between two blocks of wood and clamp it securely with rubber bands. Mix the Tuf-fil and resin and pour it slowly into the mold, allowing the air to escape from the vent. You can eliminate surface air bubbles in the casting by brushing a coating of resin over the two mold halves before they are mated. Leave a generous amount of resin in the sprue to take the place of any air bubbles that rise to the surface. You can squeeze the mold with your fingers to "burp" out large air bubbles.

When the resin in the sprue has cured, open the mold and remove the casting. Check for air bubbles. Not all of your castings will be perfect, but with some experience under your belt a rejection rate of one casting out of five is achievable. The RTV has a tendency

to inhibit the surface cure of polyester resins, so your castings may be a little sticky or have surface blemishes when they are first removed from the mold. The stickiness goes away in a day or two, and surface goo can be wiped off with acetone or liquid plastic cement.

This system is simple enough that even a beginner can get good results on the first or second try. Simple pieces with flat, undetailed backs can be cast in one-piece molds by gluing the flat surface to the bottom of the mold box. Both special parts, the pilaster and the rows of books, made for the shadow box in Chapter 13 were cast in one-part molds.

Detailed furniture and complex equipment. When your diorama includes residential buildings, you may need furniture that is a little more elaborate than simple sticks. Building such pieces could be complicated and time-consuming if you had to make each item entirely from scratch, but there is no reason to do it the hard way.

This is an excellent opportunity to exercise your ingenuity as a creative scavenger, and the best picking grounds are, as usual, the model railroad section of your hobby shop. Several companies make metal or plastic porch posts that can easily be modified into nifty table legs. By varying the sheet styrene top, you can swiftly put together round and oval tables, dining room tables, coffee tables, and even drop leaf tables. They'll even be a matched set! Porch posts can also be modified to make chairs, with epoxy putty upholstered seats. There is a wide variety of model railroad architectural details—eaves, braces, cornices, corbels, roof ornaments, windows, and doors—just waiting to be turned into fancy furniture.



This sofa in the wrecked building on the Sturmpanzer IV diorama was built from the back seat of a car kit, and detailed with

HO balcony railing and Plastruct shapes. Note the broken spring and the stuffing coming out of the seat.

Ground support equipment, particularly equipment appropriate for modern jet aircraft, is a sore point for diorama builders. A few pieces are available, but most equipment still has to be built from scratch. You can convert HO or O scale roadworking or farm equipment to make a few of the less specialized items, but you'll have to build most service units from sheet styrene and settle for detailing them with scrounged parts. The heavier Evergreen Scale Models styrene strips are really handy here. Working with nippers, you can put together the blocks that form the basic shape of a power unit or other service module in fairly short order. Piping, valves, gauges, and other details can come from the model railroad department, and even the cheapest toy cars and trucks will furnish well-detailed wheels.



This service unit was built by the Monogram shop, and consists of sheet styrene, a block of basswood, aircraft wheels, solder for hoses, and nylon shoelace for cables.

Superdetailing, battle damage, and interiors

Superdetailing is a subject that could fill a whole book. Here, we are concerned only with the kinds of superdetailing that are most frequently called for in dioramas

Articulating aircraft control surfaces. One of the most frequently called for modifications to aircraft is repositioning the rudder, elevator, ailerons, and flaps. While it is standard procedure in peacetime to lock control surfaces in their neutral positions, this practice was often allowed to lapse in wartime. Since the controls have individual locking systems, you can choose which ones you allow to hang loose. If the pilot's foot pedals are unlocked, the rudder will swing to one side or the other depending upon which way the pedals are pushed (if the pedals are visible on your model, make sure that the pedal is pushed forward on the side to which the rudder is swung). The elevator will be down if the stick is forward, and the ailerons will shift if the stick is to one side or the other (stick to the right—right aileron up, left down). The landing flaps will most likely be down on aircraft that have just landed, and the trim tabs (the small control surfaces built into the trailing edges of the larger ones) are often seen at odd angles when the plane is on the ground.

Most kits come with the control surfaces molded in the straight position as parts of the wings, fuselage, or stabilizers. To articulate them, you will have to cut them out with a saw or knife and replace them in the desired position. The most efficient way to do this is with a thin 1" circular saw mounted in a hand motor tool. The plastic cuts easily, you have excellent control over the tool, and the cutting line is thin enough that both pieces are salvageable. The alternate methods are to cut through the plastic with a knife, or to use a razor saw to cut through the two accessible edges of the flap, scribe the third edge halfway through with a knife, then snap the panel free.

Before cementing the control surface back in place, you may have to build up and round off its hinge edge. This rebuilding can be done with sheet styrene, epoxy putty, or a combination of the two. Use a sanding block to round off the edge. Seal off the ends of flaps with sheet styrene. On large-scale models, you may want to add bracing or other detail on the flap ends.

Now bevel the inside edges of the areas on the fixed structure of the aircraft until they mate properly with the curved edges of the control surfaces. Sand, carve, and file for a few

minutes, then check the fit. Continue until a good fit is obtained. It needn't be perfect—a scale 1" gap is quite acceptable as long as it is consistent along the length of the movable section.

Don't forget the actuating rods, the operating devices connected to the cables that lead to the controls in the cockpit. On the larger control surfaces they are mostly internal, but the trim tab actuators are usually outside the wing. The small arm on the tab can be made from sheet styrene, and the rod that pushes it fashioned from wire or stretched sprue.

Removing access panels. Most aircraft maintenance scenes call for access panels to be removed, revealing the hardware that is being worked on. The first step in removing a panel, whether it is a cowling, engine nacelle, or fuselage panel, is to make sure that it was removable on the original aircraft. Access panels are removed in the same manner as the control surface pieces. Again, the best method is to use a thin-bladed circular saw in a motor tool, since this leaves the panel salvageable. The alternative methods are to cut out the panel with a knife, or to drill a series of holes around the edge of the panel, then cut away the plastic between them. Once the panel is removed, carefully trim the edges of the



Cutting and repositioning control surfaces such as flaps and ailerons is a subtle way to add realism to aircraft models



Most folded-wing carrier aircraft can stand some extra detailing in the wing roots. Here's an example



Any aircraft maintenance scene requires that one or more access panels be removed. This diorama of a P-61 in the South Pacific is a fairly complicated example: both the engine nacelles are stripped, one engine is removed, the gun bays are open, and the nose fairing is removed to service the radar.

opening and carve away the inside edge so that the aircraft skin appears thin. Use narrow strips of .010" styrene to add the framing around the edges of the opening, and drill a series of fastening holes in it with a pin vise or Dremel tool running on very low speed.

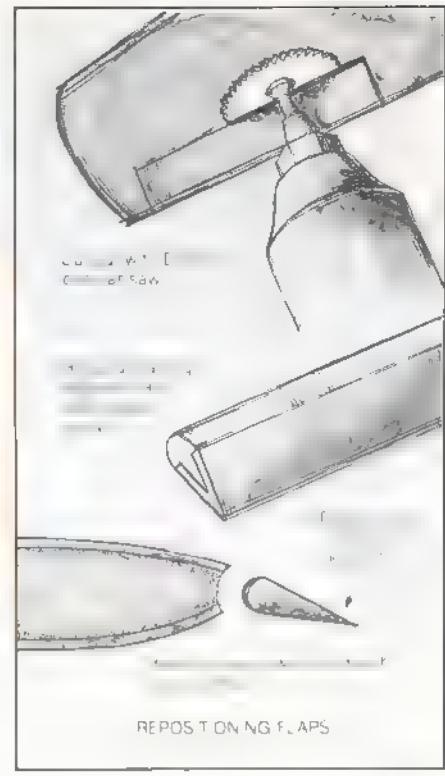
Don't forget the panel you removed. The plastic piece is far too thick, but you may be able to bevel the edge to make it look thin. A simple alternative to using the kit part is to vacuum-form a thin plastic panel over it. This provides a thin version of the original, accurately curved to match the contour of the plane. Don't forget to drill the fastening holes around the outside edge of the panel. Be careful to space the holes evenly; if you do a lot of this sort of work, it is worth the time to build a simple drilling jig.

If you are ambitious enough to remove more than one panel, you'll have to model some of the exposed framework. This is easier than it looks. Before you do any cutting, assemble research material. What does the engine look like—front, back, and sides? How is it mounted to the airframe? What does the nacelle look like with the engine removed? Is there a fire wall? What kind of electrical, hydraulic, and fuel connections are present? You should have answers to all of these questions before you begin.

The example shown is an exposed engine nacelle framework on the Monogram 1/48 P-61. Each engine assembly and mounting will be different, so the exact method will vary somewhat, but the basic principles and procedures remain the same. The first step was to cut away all of the engine nacelle panels that were to be re-

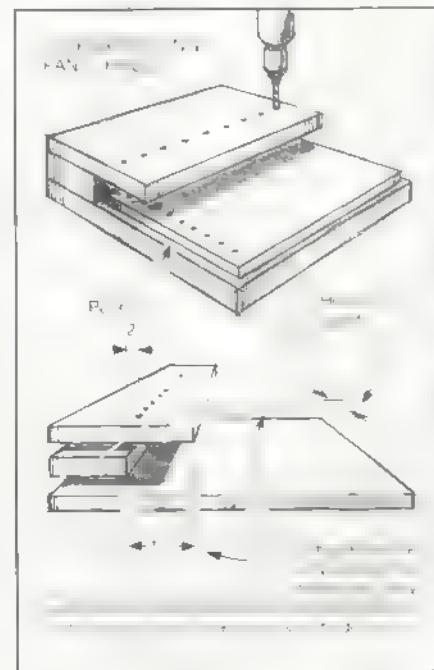
moved, cutting along panel lines. This leaves a gaping hole in the wing that immediately makes you wish you hadn't done it. The next step on the P-61 was to install the fire wall. The fire wall was cut from .020" styrene sheet to match the inside shape of the nacelle, and glued in place. This left a narrow rim showing around the bottom edge of the nacelle, which was drilled out to resemble framing. The fire wall was detailed with Plastruct framing and scavenged parts that duplicate electrical, hydraulic, and fuel connections to the missing engine.

The panels near the leading edge of the wing were beveled to appear thinner, and a circular frame cut from



styrene with sharpened dividers was glued in place. Additional framing was added using sheet styrene, and pieces of plastic drinking straw were used to simulate the air ducts.

Detailing engines by "creative gizmology." The next step on the P-61 was the engine, which was to be suspended from a hoist, completely clear of the aircraft. Starting with the engine provided in the kit, holes were drilled at intervals around the bullet-shaped crankcase and fine wire solder glued into them. These wires were then cut to length and positioned to dupli-



Engine nacelle detailing for the P-61 is shown here in progress. The cuts in the nacelle area have been made, and the scratchbuilt engine support framework and fire wall are in place.



After going to all the work of making an accurate replica of a Pratt and Whitney R2800 engine for the P-61 diorama, I decided to hang the engine in midair from a portable hoist where all the intricate detail can be appreciated.

cate the ignition collars. Circular cowling frames were cut from styrene, drilled, and mounted on the cylinder banks. There should be two rows of fastening holes around the outer rim of the frame, but even with the smallest drills there is only room for one. The cowl flaps were cut from the kit and mounted on the second ring.

Final detailing of the engine involved an indispensable technique that I call "creative gizmology." This is the use of many plastic bits and pieces scrounged from various kits to simulate complex machinery. The most famous examples of this technique are the spacecraft created for films such as *2001: A Space Odyssey* and *Star Wars*. These models were detailed with parts scavenged from every plastic kit imaginable. The best source for gizmos is



Plastic model railroad parts by Cal-Scale and others are an important resource for engine and cockpit detailing. Brass parts are also useful, but more expensive. HO scale brake system parts are especially versatile.

the model railroading department of your hobby shop. Cal-Scale, Grandt Line, and other firms offer brass and plastic detailing parts for HO scale railroad cars and locomotives. The brass pieces can be expensive if you need them in quantity, but the plastic items are cheap and the detail is simply amazing.

You will not want to use unmodified railroad parts often, because they soon become recognizable even to fellow airplane modelers, but you can cut them apart and recombine them to your heart's content, and this is really the crux of "gizmology." I offer no apologies for the modeling inaccuracies inherent in "gizmology," because the purpose of this technique is to simulate complex mechanisms that would be exhausting to make any other

way; from a purely practical viewpoint, "gizmology" yields 90 percent of the results of painstakingly accurate modeling in only 10 percent of the time. This is not, however, a license to conjur up unlikely mechanisms out of thin air. The idea is to use available parts to represent mechanisms that actually existed, not to create new ones of your own.

Another important material for detailing complex mechanical systems is wire solder. This is the same solder used for wiring and working with brass. Hardware stores and electronics supply houses stock three or four sizes ranging from $\frac{1}{8}$ " in diameter down to about $\frac{1}{32}$ ". Smaller sizes, down to .010", can be obtained from solder manufacturers, who will even make up spools to your specifications. A spool of



One spool of .015" solder like this will last an active group of modelers for several years and dozens of projects.



All of the various pipes, tubes, and wires on the engine mount of this derelict B-25 were made from small-diameter soft wire solder.

very fine wire solder can cost upwards of \$15, but if a group of modelers gets together to split the cost, the solder is well worth the expense and there will be plenty of the small-diameter solder to go around. The great advantage of wire solder over other wire is that solder is extremely flexible and stays exactly where you put it. It can be twisted and braided into cord, or formed into other intricate designs.

To get back to our P-61 example, the gearbox behind the Wright Cyclone engine was made of Plastruct tubing, with nut-bolt-washers added around the rim and the end of an HO air reservoir used to cover the hole in the center. Wiring, hydraulic lines, oil reservoirs, pumps, and generators were built up from HO railroad parts. The air filter assembly was added using Plastruct tubing, with bolts, hooks, and other details by Grandt Line. The engine framing, which attaches to the fire wall, was made of brass rod and styrene. Additional details on the front of the engine included new covers for the magnetos and a governor assembly between them. Strips of stretched sprue were cemented around the prop shaft to provide the proper grooves.

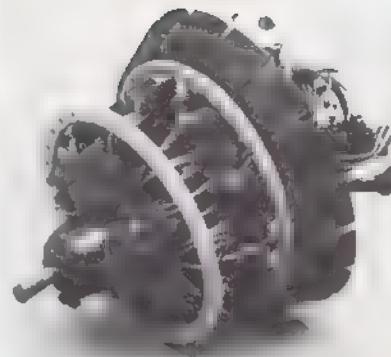
Other mechanical details on aircraft can be modeled in much the same manner. On the P-61 the detailed areas include the gun bays and the nose radar. The P-61's guns were electrically loaded and fired, so there was a lot of gadgetry mounted in the real bays. Very little of this clutter would be visible in the finished diorama, but the bays looked unrealistically empty. No real effort was made to duplicate actual assemblies point for point; the goal was simply to create the appearance of a lot of gear when seen from the usual viewpoint. This is a rare case where "imagineering" is not only permissible, it is essential. Any effort made to get all of the details right in this area would be strictly a matter of personal satisfaction, because little of the work could ever be appreciated.

The "imagineering" approach was clearly out of the question for the radar gear, since it is right up front in plain sight. The gear provided in the kit was adequate, but seemed sparse when compared to photos of the real plane. A few railroad gizmos and some solder "plumbing" provided the required extra detail.

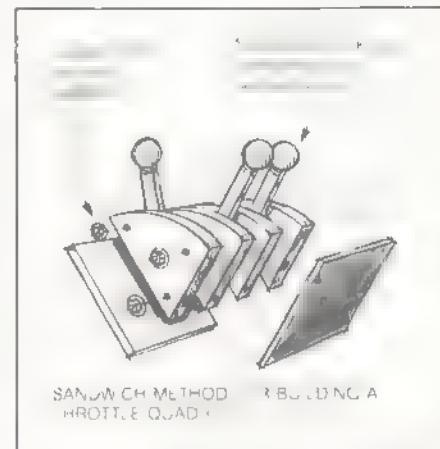
Cockpit details. Aside from the engine and mechanical equipment compartments, the part of an aircraft that cries out most for superdetailing is the cockpit. Before you start, make sure that your efforts will be visible; the open cockpit of a fighter will show much more detail than the enclosed flight deck of a bomber. Make sure you have adequate reference material on how the real aircraft cockpit looked.

Detailing is largely a matter of being resourceful and employing "gizmology." Use railroad parts, supplemented by solder wiring and piping, and scratchbuilt accessories. Make toggle switches by drilling holes in the instrument panel and inserting bits of stretched sprue from behind. If the switches stick up too far, they can be trimmed in place once the glue has dried. Throttles can be made by sandwiching sheet styrene and stretched sprue, and throttle knobs can be formed by holding the end of each lever near a soldering iron or candle. Gun sights are made from sheet styrene, a few railroad parts, and clear plastic. If the kit seat is wrong, a correct pattern can be made from wood and a proper one vacuum-formed, with cushions added from epoxy putty. Seat belts and parachute harnesses can be made with cloth adhesive tape. Waldron Model Products makes 1/72, 1/48, and 1/32 scale buckles, hinges, foot pedals, and other cockpit details.

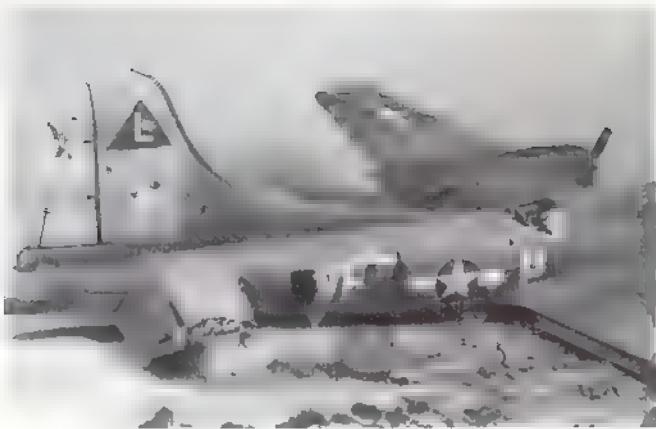
Parachute stowage is an important aspect of cockpit detailing. Particularly on carrier-borne aircraft, the chute doubles as the seat cushion and the pilot buckles his harness to it when he sits down. In other cases the harness is permanently attached to the chute, but the whole rig is left in the plane, spread over the back of the seat. Another practice is for the pilot to put on the entire rig, either a seat or backpack, before entering the plane. In larger multi-engine WWII aircraft it was common practice to wear only the



The P-61 engine looked like this before painting. The engine is quite accurate in spite of some minor solder and railroad parts "gizmology."



Cockpits, particularly modern ones, just cry out for superdetailing. Dave Smith's A-10 is an excellent example of the level of detail that you can achieve with careful work.



Don't get carried away when modeling battle damage. Although this B-17 is in pretty rough shape, it is still flyable.

harness and carry a detachable chest or backpack, which was stowed out of the way and clipped on only in an emergency. Find out which method was used on the aircraft you are modeling, and take the time to install it properly.

Battle damage for aircraft. Battle damage, either old or new, adds a lot of character to diorama aircraft, but be careful not to overdo it. Older damage usually takes two forms, patches on the skin of the aircraft (make these from .005" styrene, glued in place and sanded and steel-wooled down until they are barely visible), and replacement parts of different colors, either faded parts cannibalized from wrecks or freshly painted new ones. During the transition of U.S. aircraft from olive drab to natural metal during WWII, it was not uncommon to see both colors intermingled. The most famous example was the B-17, *Little Miss Mischief*, a silver plane that was olive drab from the wings back.

New battle damage consists mostly of bullet or flak holes in the plane's skin. The best way to make bullet holes is not to punch a hot needle through the plastic, but to thin the plastic out from behind until it is translucent, then

punch and twist in the holes with a knife point. Entry holes should be punched from the outside so that the edges are pushed in, and exit holes punched from the inside, so that the jagged edges are pushed out. Larger holes are made the same way, but bear in mind that where extensive damage reveals the plane's internal structure, the framework must be added to your model. Bent and twisted remains of structural shapes are easily made from plastic sheeting and strip. In a few cases it is easier to heat and twist the structures once they are in place on the model, but it is usually better to form them before installation.

Other indications of aircraft battle damage are catastrophic oil leaks from the engines and wide smoke streaks from failed engines. Engine malfunction, either as a result of enemy action or simple breakdown, can be indicated by feathering the blades of the prop, turning them 90 degrees to reduce drag. Simply cut the blades off the model prop and cement them back in the feathered position.

When adding battle damage to an airplane, think carefully about what you are doing. If your plane has crashed, you can simulate any kind of

damage, but if the machine has returned home safely, make sure the wounds you inflict are not obviously mortal ones. The safest procedures are either to model your damage directly from photos of a single aircraft, or to research the design of the plane to ensure you don't damage too many vital systems at once. For example, the B-17 was famous for the punishment it could take and still fly home, and while the B-24 could absorb equal abuse in some areas, its Davis wing and awkward tail were quite vulnerable—extensive damage in these areas was usually fatal. Most multi-engine aircraft could fly on only one engine, although this frequently called for exhausting effort by the pilot.

The fuselage of most planes could absorb a great deal of damage without affecting airworthiness, and most "home on a wing and a prayer" cases suffered the bulk of their damage in the fuselage. The most vulnerable items in the fuselage were the control cables, which ran from the cockpit or flight deck aft to the rudder, elevators, and ailerons. These cables usually ran along the upper port side of the fuselage. A plane could still be controlled if only the cables running to the tail were



To make convincing bullet holes, first thin the plastic from the inside, then punch and twist the holes with a knife.



The ragged metal edges in the top of this wing show that the flak came from below. Large hits require that you model some



internal structure. The damaged engine on the same aircraft includes extensive flak damage in the cowl and prop.



This Tamiya Tiger I can be disassembled to show off the interior, so I went all out and added complete detail to the fighting

cut, but if they were all gone, the plane could not fly.

Modeling fuel tank damage also calls for restraint. You can locate the fuel tanks by the round filler caps on the wings. It is all right to punch bullet holes in them, since nearly all tanks on Allied and German aircraft were self-sealing, but few planes could survive major flak hits in the tanks without bursting into flames.

Superdetailing armor interiors. Few armor kits contain interior detail, because such detail can rarely be seen. Even when the hatches are open, figures in them usually obstruct the view. Generally speaking, there is no reason to include detail that can't be seen, but there will be cases where you will want to open an engine compartment for maintenance or have hatches in the fighting compartment open, and interior detail will be required.

The first step is, as with aircraft, to assemble research material. The exact interior layout is different for each tank, but the general nature of the detail is pretty much the same, consisting of boxes and bins welded to the turret walls and various other gear hanging on hooks. If only one hatch is open, a mere suggestion of an interior is sufficient, perhaps a simple gun breech, some plastic blocks glued to the inside of the hull, and a hint of wiring. You can duplicate the real vehicle item for item if you wish, but you'll find that in a dark interior, a "suggestive" approach is just as effective and a lot less work.

If all the hatches are to be open, the amount of work you'll have to do increases. There must be more to see, because more light will be admitted. The first step, however, may be to open the hatches themselves. While more and more kits come with separate hatches, sooner or later you will have to open a hatch that is molded shut. Use a thin-bladed circular saw in a motor tool, but do your final trimming with a knife. If the hatch cover is a



compartment. Tanks are literally crammed with equipment, so detailing them presents a modeling challenge.

separate molding, the job is pretty much done once the hole is cut, but if the hatch is molded on it will almost invariably be damaged by the cutting. Try to avoid damaging any of the surface details on the hatch. Most hatches are simple flat plates that you can make easily from sheet styrene, and details can be transferred from the original hatch to the new one. Shave off smaller bits such as screws and hinges with a sharp knife. Larger details, such as vision block covers and periscope housings, are more difficult to remove; in fact, it is often easier to remove the hatch from the detail rather than the detail from the hatch. Cut away the hatch from around the detail, leaving a small thickness of hatch. Sand away the excess material, and the detail is ready to glue in place on the new hatch.

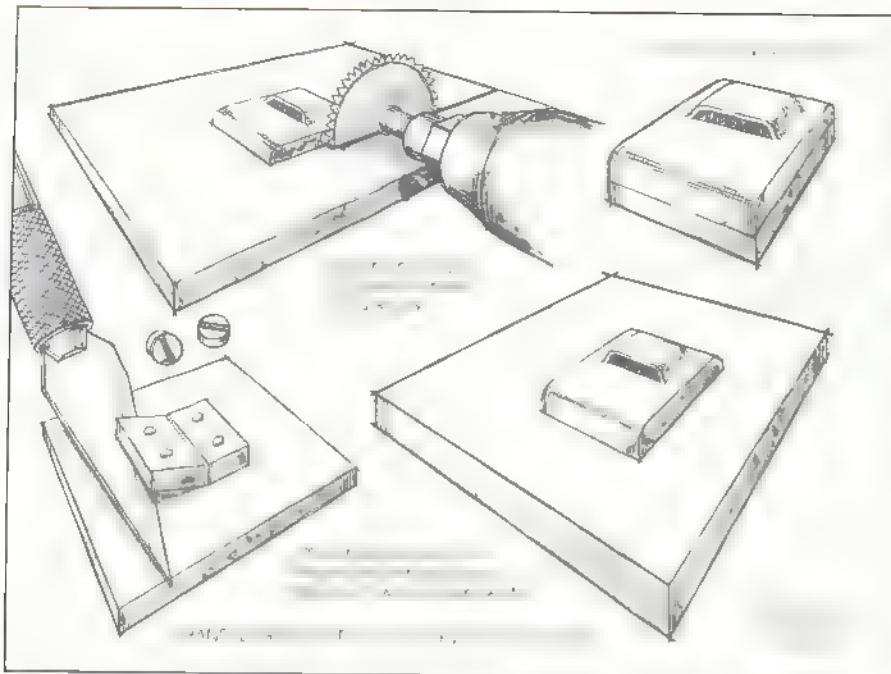
Detailing the fighting compartment of a tank involves the same "creative gizmology" process used on aircraft. Various interior details can be made from raw plastic stock, but the judi-

cious use of parts cannibalized from other kits will make the job a lot easier. Dashboards, steering wheels, and other parts from car kits are especially handy, and road wheels and other parts from tank kits are useful for making transmissions, elevation wheels, and similar gadgets. That limitless store of detail parts, the model railroad department, can provide all sorts of goodies. Unless you are determined to build a completely accurate interior, remember to check your work every so often to see what will actually be visible through the hatches. There is no point in detailing areas that won't ever be seen, and you may also find a few areas you had overlooked.

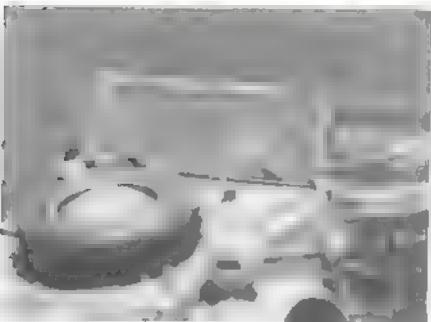
Few modelers open the engine compartments on their tanks, but if you choose to do so, you don't have to build an engine from scratch. Truck and car kit engines can easily be adapted to tanks. The U.S. Lee, Grant, and some Sherman tanks used radial aircraft engines which can be taken from 1/32



This Monogram panzer IV was converted from an "H" configuration kit to the earlier "E" version, and I included a detailed interior. Most of the work was done with parts left over from other projects, and liberal amounts of sheet plastic.



Zimmerit was a cement-like material applied to German armor during 1943 and 1944 to prevent magnetic mines (placed by infantry) from sticking. To simulate it, apply green putty or acrylic modeling paste to the side of the hull and spread it with a piece of HO corrugated roofing or section of razor saw blade. Jog the spreader to one side every quarter inch or so to break up the pattern.



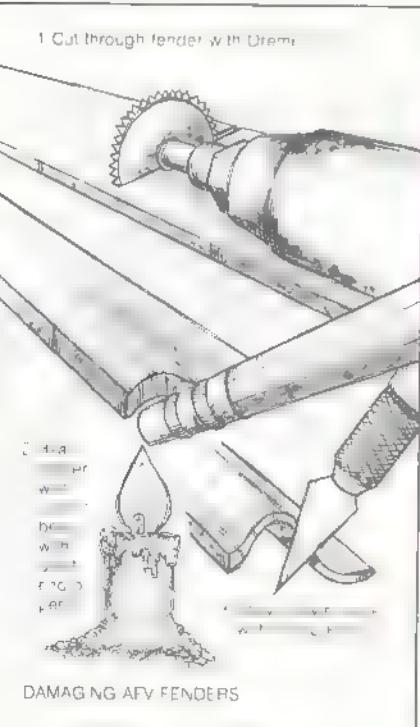
The realistic bullet hole in this scratch-built sheet styrene windshield was made by drilling a hole and then scribing the radiating lines with a knife.

scale aircraft kits. Don't neglect the possibility of using in-line engines from 1/32 or 1/24 scale aircraft, either. You may have to do a bit of searching to find the engine that best suits your requirements, but there are plenty to choose from.

One glance at a photo of a real tank engine compartment shows that it is crammed with wires, hydraulic lines, and accessory equipment. If you want to build a completely accurate model, you have a lot of work ahead of you. If, on the other hand, you just want to create the appearance of the real tank, get a few photos or drawings to give you a visual impression to work from and start looking for parts that are *close* to the originals. The car or truck kit you swiped the engine from is an

excellent source; hubcaps, for example, make excellent air filters. Ignition wire harnesses and hydraulic lines are best duplicated with wire solder.

Battle damage for armor. Tanks take a terrific beating in battle, and any armored vehicle that has been in the field for more than a few days will show wear and tear. Fenders and mudguards are flimsy sheet metal, and they bend and twist easily. Damage of this sort must be built into the model before assembly because the process calls for heat, and you want to ensure that the only part distorted is the fender. Hold the fender over a candle and push on it with the blunt end of a pencil to determine when it becomes rubbery. Then use the pencil to distort the fender into the desired shape. If the



Glancing blows like the ones that caused the shot damage on this Monogram Grant were not altogether rare, but they were unusual. Don't overdo such damage.

beat rounds off the edges of the plastic, scrape with a knife to restore the crispness of the edge. Do this only after bending, otherwise the heat will cause the thin edge to curl back unrealistically. Occasionally, sections of fender are torn off altogether. Modeling this is simply a matter of cutting off the required part and thinning the edge of whatever remains.

Damage caused by enemy fire usually consists of gouges or pockmarks on the surface of the armor plate. Although an occasional gouge is an effective and dramatic device, don't overdo it; try not to put more than one or two such marks on the same vehicle, and don't make a habit of it on every tank. Most tank battles take place at sufficiently short ranges that any hit is likely to be lethal, and glancing blows are the exception rather than the rule.

Non-armored parts of the vehicle, such as fenders, stowage bins, and canvas mantlet covers, are highly susceptible to high-explosive, armor-piercing, and small arms fire. Shrapnel holes in the stowage bins are commonplace, and in some photos these bins have literally been blown to shreds. Distortion of non-armored features is accomplished using the same heat process used for fenders, while holes are made by thinning the plastic from behind, then punching and twisting the holes with a knife.

Most German vehicles in the latter part of WWII carried supplementary skirt armor along the sides. This served as protection against the shaped-charge projectiles of infantry weapons. These shells detonated on impact, and the skirts detonated them prematurely, dissipating the force of the explosion before it reached the main armor plate. This supplementary armor was about $\frac{1}{4}$ " thick and hung in sections on frames welded to the sides and fenders of the vehicle. Skirt armor was frequently blown off in action, and it is not uncommon to see photos of



The rear deck of my Tiger I includes bent brackets for the air cleaner tubes, a spare road wheel, tears in the screening over the air intakes, and shrapnel holes in the exhaust covers.



The bent and battered appearance of the light sheet metal stowage bin on this panzer IV E was achieved by first gouging the plastic with a steel cutter in a Dremel tool, then smoothing the gouges with steel wool.

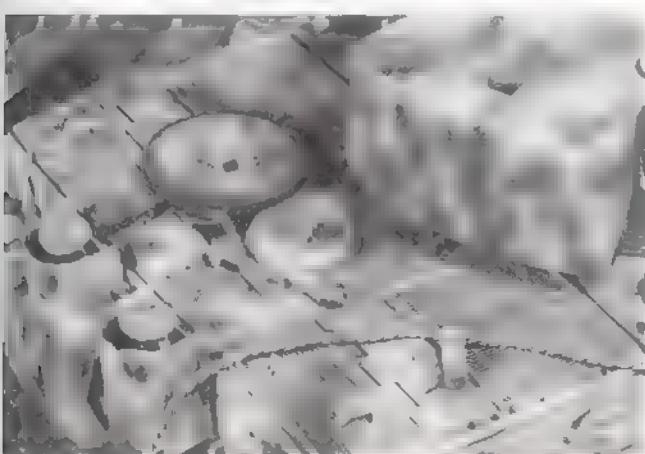
vehicles with sections missing and the frames battered and twisted.

Knocked-out and abandoned tanks. There is little difference between a knocked-out tank and an abandoned one. Tanks are abandoned because of mechanical failure, and whenever possible they are sabotaged before the crew leaves. Thermite grenades are often used to freeze or explode the breech block of the gun, or to burn out the engine. In other cases the oil is drained from the crankcase and the engine left running until the cylinders freeze up.

Before we discuss modeling knocked-out tanks, let's examine how they are knocked out. The most common anti-tank projectile during WWII was a high-velocity solid shot that was intended to penetrate the armor and then bounce around inside the tank. This shell created a small ragged hole at its point of entry, and unless it touched off a secondary explosion of the tank's ammunition, this hole would be the only damage visible from outside. Infantry antitank rocket launchers use a shaped charge that concentrates its entire explosive force on an area about the size of a coin, literally melting a hole through the armor and

spraying the inside with molten metal. This, too, leaves only a small hole, but a hole with melted rather than ragged edges. A modern development is the "squash head" shell, which does not penetrate at all, but hits with such impact that it breaks lethal particles loose from the inside walls, ricocheting them around the interior. The actual mark of the fatal shot, therefore, is not hard to duplicate on a model tank. Doing so is simply a matter of drilling a hole and either chipping or beveling the edge.

Most photos of knocked-out vehicles show all the hatches open, which makes a considerable portion of the interior visible. Fortunately, you can smoke-blacken the interior, which greatly reduces what can be seen. Breaking loose some of the side-wall stowage gives a devastated look to the interior, and one of the most effective details, when viewed from outside, is a few loose wires hanging from the overhead. If the engine compartment has burned, the paint on the hatches will be blackened and peeling. This effect is easily duplicated by softening and wrinkling the paint with a little lacquer thinner, acetone, or liquid plastic cement.



German skirt armor was only about $\frac{1}{4}$ " thick, so it was quite susceptible to small arms and shrapnel damage.

When a tank burns out completely, the conflagration often spreads to the rubber on the road wheels and return rollers, and the rubber burns down to the steel rims of the wheels. To model this, remove the rubber portions of the wheel entirely by mounting the wheel in a motor tool and sanding. Road wheels with holes in them can be mounted on a screw-type mandrel, those without holes must be glued temporarily to a wood or plastic disc that can be mounted in the same manner. I use super glue for this purpose, because it is strong enough to hold under the stress of the work, yet can be dissolved later with acetone or nail polish remover. When grinding, work slowly so that the heat does not build up and melt the plastic.

One of the most common breakdowns associated with armored vehicles is throwing a track, either as a result of enemy fire or natural wear and tear. Most tracks are composed of individual links connected by pins. When a pin breaks, the vehicle will sometimes come to a stop immediately, but more often it continues until it runs out of track. On firm ground a tank may even continue some distance further, slewing sharply toward the damaged side. When modeling a thrown track, then, you are justified in showing no track at all, only part of the track (the rest being off the edge of the base), or the whole thing. The tracks on 1/24 scale models are easiest to work with, since they usually have individual links. Rubbery "loop" track is harder to control. Make sure, first of all, that the track is detailed on both sides, since both sides will be visible. When your vehicle is in place on the

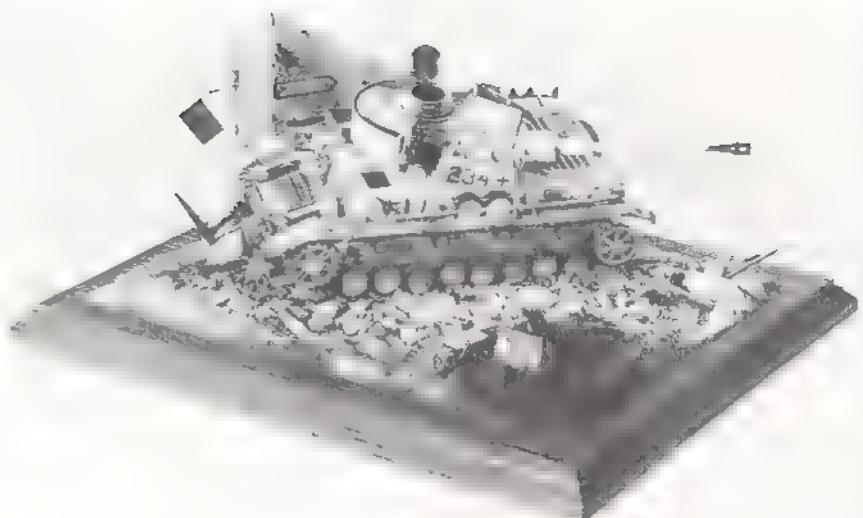


Photo courtesy Monogram Models

Note the open hatches, black smoke smudges, and burned cables hanging out of the turret side hatch of this knocked-out Monogram panzer IV. This one obviously went up like like a Roman candle when it was hit.

diorama base, position the track and secure each end with small pins. I use insect-mounting pins, because they have very tiny heads. Drill pilot holes slightly smaller than the pins in the base. Pin down each loop of track until you have the desired effect.

Tanks which have exploded are modeling challenges. Minor explosions usually do little more than lift the turret out of its ring, leaving it at a cockeyed angle, which is not at all hard to model and visually very effective. Larger explosions will crack and buckle the armor plate (armor plate does *not* bend), and occasionally pop open welded seams. The best way to duplicate this sort of damage is to scribe the desired cracks on the

underside of the armor plate and then give the model a good whack with a hammer.

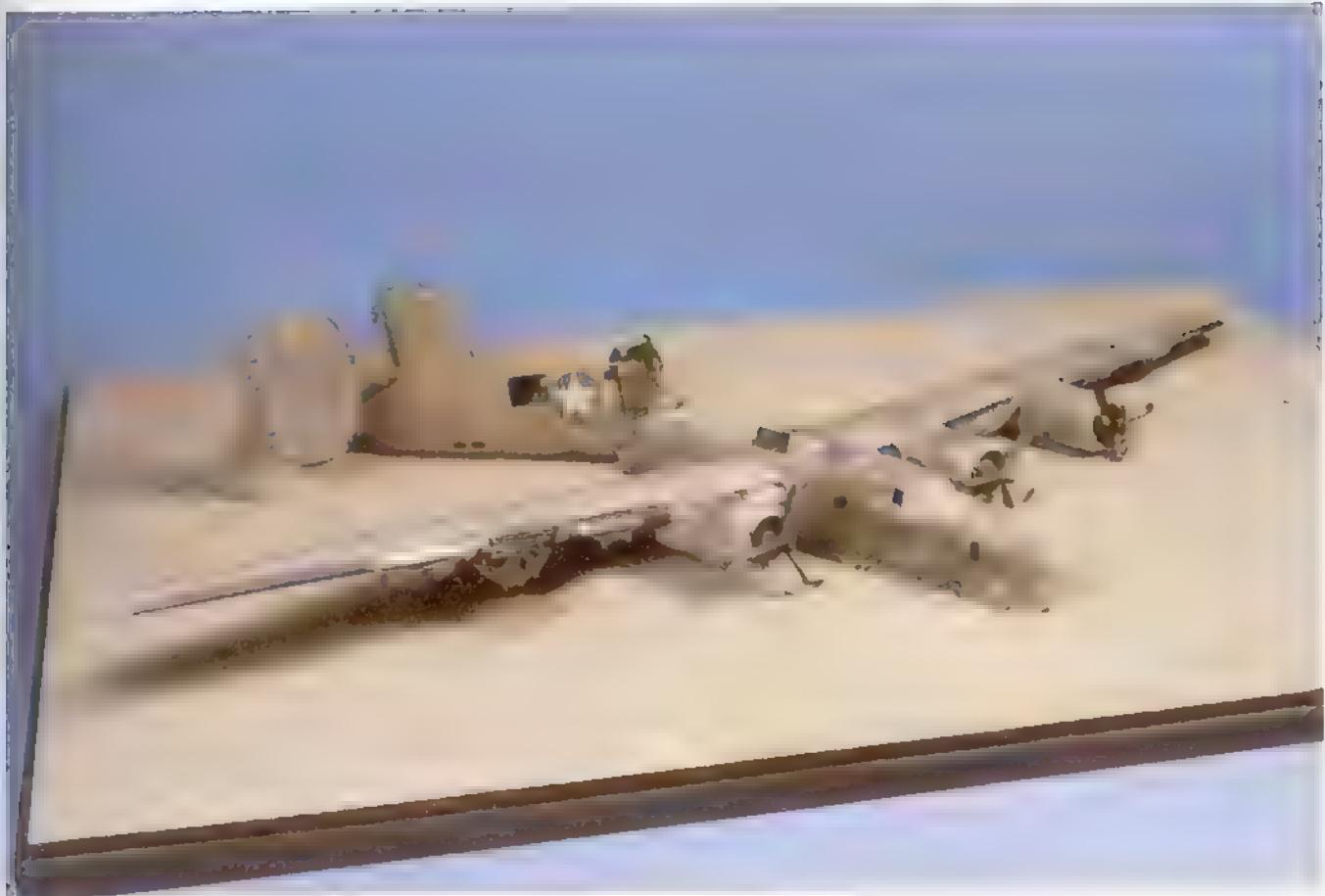
Finally, let me add a note of restraint. Catastrophic destruction caused by a major explosion will reveal the interior, which, even twisted and charred, will call for a lot of time and effort to model. There is a lot of wiring and equipment inside a tank, and when the vehicle is blown up it creates a mess that is harder to model than you might think. If it is to be done right, a shattered hulk is not a destruction job at all, but a difficult and exacting construction project involving extensive scratchbuilding. Don't try it until you are ready for it, and when you are, good luck!



My completed panzer IV E includes heavy desert weathering colors, rags hanging from the back rack and stowage bin, and open teeth on the spare tracks.



Jeff Decker's burned-out panzer III shows burnt rubber tires on the road wheels, a realistically draped thrown track, and a deformed fender on the left side.



9 Step-by-step **The Lady Be Good**

The luckless *Lady Be Good* has become one of the most famous aircraft of WWII. The B-24 was reported missing on its first mission, a bombing run to Naples from North Africa on April 4, 1943. No trace of the crew or plane was found, and they were presumed lost at sea. Seventeen years later, an oil search team came across the wreckage 300 miles deep in the Sahara Desert.

The wreck was perfectly preserved by the dry desert atmosphere; the guns worked, coffee in the thermos bottles was still palatable, and the hydraulic systems were functional, but there was no sign of the crew. An aerial search turned up rescue markers set up by the crewmen as they walked across the desert, and slowly the pieces of the puzzle began to come together. After overshooting their base, the crew had made a navigational error, and instead of turning back had flown deeper and deeper into the desert. When they were

nearly out of fuel, the crew jumped. Ironically, they wore their Mae Wests and took their life rafts (they thought they were still over the Mediterranean), and the unmanned aircraft crashed into the desert.

As soon as the crew touched down on sand, they realized their error and began the long trek back toward Benghazi. How far they got was unknown until a year after the plane was discovered, when an exhaustive search located the bodies of five of the crew, 60 miles from the wreck. A diary found at the site revealed that three more crewmen had continued on, and two more bodies were found 30 miles beyond. The last crewman was never found.

Today, Robert Toner's moving diary can be seen along with other items from *Lady Be Good* in the Air Force Museum in Dayton, Ohio. The *Lady* herself rests undisturbed on the floor of the Libyan desert.

I had always wanted to build a diorama of the *Lady Be Good* and waited for a number of years for a model of the B-24D. An examination of the Monogram 1/48 B-24J revealed that conversion to the earlier "greenhouse nose" D version would not be difficult, and I decided not to wait any longer.

Research material on the *Lady Be Good* is plentiful. My primary sources were an article in *After the Battle* (No. 25), and one in the International Plastic Modelers Society Quarterly. There was some doubt as to whether the plane had a ball turret (which would have been visible at the break of the fuselage), but a phone call to the Air Force Museum revealed that it did not.

I decided to show the *Lady* as she appeared before discovery. Figures would only distract from her desolate mood, and after she was discovered, a lot of the equipment was stripped from her.



The first step in modeling the Lady Be Good is to mark out the break in the fuselage and the portion of the bottom that will have to be removed. Since the plane is somewhat down on the port (left) side, the starboard side of the fuselage should have a little less removed. The nose turret area is also to be cut off.



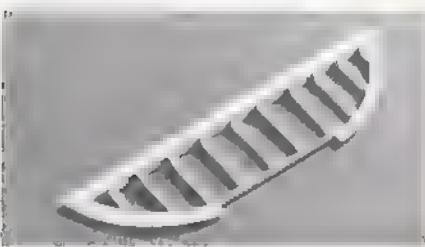
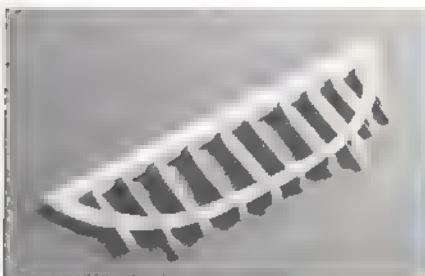
The wrinkles in the aircraft skin were made with a Dremel tool, then smoothed over with steel wool. The openings behind the dorsal turret are the life raft compartments. Also visible is the small sheet styrene rim added to the nose to support the clear nose bubble. The heavy bulging effect was created with epoxy putty. The B-24 was a notoriously bad "ditching" aircraft (the reason the crew jumped instead of going down with the plane) and in crash landings the fuselage often crushed like an egg.



The rear part of the fuselage was the only part of the plane that called for interior detailing. The glass would all be frosted by sandstorms, and the break at the front of the fuselage is discreetly hidden by the tattered curtain (epoxy putty) of the radio compartment. Oxygen tanks from the Monogram B-25 were installed, two overhead forward of the waist positions and eight on the sides and overhead behind them. The distorted skin of the fuselage was accomplished by thinning out the plastic with a Dremel tool and steel cutter, adding wrinkles at the same time. Sheet styrene ribbing was then installed, and gentle heat applied to warp the surfaces.



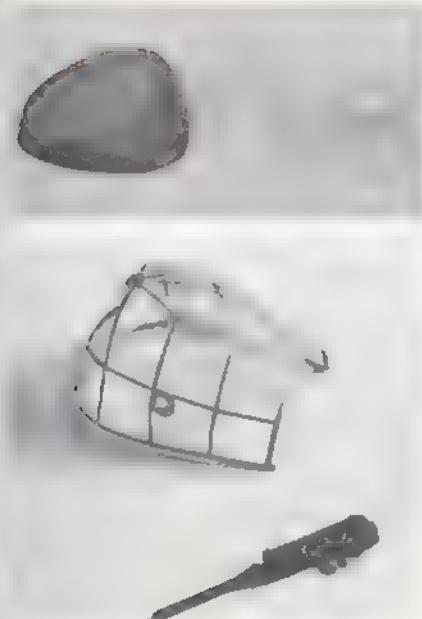
At the time of the landing, the plane was flying on only the No. 4 engine, which wrenched from its mounts and kept flying for another hundred yards after the plane came to a stop. This picture shows the initial step in constructing the engine mount. The engine nacelle has been cut away, and sheet plastic has been installed along the wing.



One rudder has lost all its fabric covering and had to be built from scratch. The thick vertical spine and curved rim are assembled first, then oversize horizontal ribs are glued to either side. When the glue is dry, excess material is trimmed off and the final version sanded to shape, with the ribs tapering toward the rim. Note how a section of the rim has been removed where the trim tab would fit.

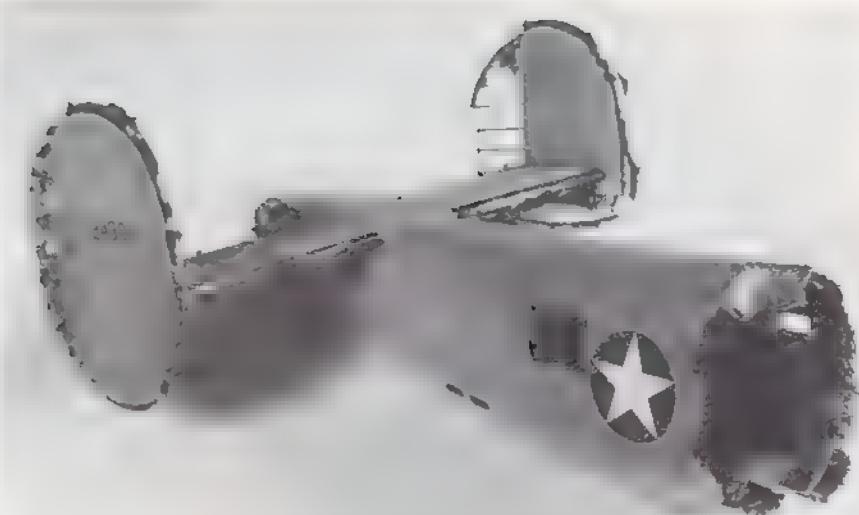


The tail shows the extensive rotting of the fabric surfaces, done in the same manner as bullet holes—thin out from behind, and punch and twist the holes with a knife. The tail turret was slightly modified to the correct B-24D configuration by cutting away the glass near the guns and installing sheet styrene inner walls.



The most noticeable difference between the B-24J and the B-24D is the nose. A wood pattern was carefully made slightly smaller than the nose to allow for the thickness of the plastic to be formed over it. Clear ABS (Plastruct) plastic was then vacuum-formed over it. On the left is the wood pattern, on the right the formed nose. The ribbing on the nose was applied with strips of paper, painted chromate green on the inside and desert tan on the outside. These strips were glued in place with white glue—not very strong, but any excess can be neatly wiped off the clear plastic with a damp rag. Since part of the nose is buried in sand, only a partial nose bubble was needed.

The groundwork is very plain, consisting only of Cellucray covered with sand. The fuselage halves were pressed into the surface and left there until the Cellucray was reasonably firm, then removed



Because no decals were available, the nose numbers and Lady Be Good were hand painted. The rotten rubber peeling away from the deicer boots was achieved using the rubber cement masking trick used for peeling paint. The hanging sections of rubber were made from epoxy putty. This peeling effect is particularly striking on the tall section.



by overspraying with matte varnish.





A closeup of the remains of the No. 4 engine. I had good photos to work from, and this detail is quite accurate. The straight cables and tubes are brass wire, the bent and twisted ones solder. Other than a few Grandt Line nuts, a little brass tubing, and some stretched sprue, that is all there is. The chipped paint effect was done with a brush and silver paint.



A closeup of the No. 2 engine. Notice the bent and feathered props, and the dents in the cowling.



Structures for dioramas

Building structures is a rewarding extension of your modeling skills, and it opens a wide range of diorama subjects for you. Structures offer a whole new area in which to exercise your imagination, ingenuity, and eye for detail. There have been a number of excellent books on structures in the model railroad field, and these cover most of the basics. This chapter will deal only with the more specialized subject of war-torn buildings, the kind that are most often required for military dioramas.

Simple rural structures. The simplest form of structure to build, the type you will require most often, is a simple single-story dirt-floor farm building, usually a barn or outbuilding. The most significant difference between modeling structures in the common model railroad scales and 1/35 scale is the thickness of the walls. This thickness is clearly visible in war-damaged buildings, and rules out using the time-honored method of building a shell out of cardboard, styrene, or basswood.

The easiest method of providing proper wall thickness is to use plywood. Either $\frac{3}{8}$ " or $\frac{1}{4}$ " is satisfactory; $\frac{3}{8}$ " provides a 1/35 scale wall

thickness of about 12", while $\frac{1}{4}$ " scales out to a thickness of about 8". The first step is to draw up the plan of the walls on the plywood. If you made cardboard mock-ups while planning your diorama, these can be used as templates. The easiest way to cut the plywood is with a jigsaw, or you can do it by hand with a coping saw. You will have to drill starter holes for the windows so that you can insert the blade through the plywood.

An alternate method of building walls is to use pre-cut strips of $\frac{1}{4}$ " basswood (2" width is most convenient), cut to length and glued together. This technique is fast, and is particularly useful for buildings that call for a lot of evenly spaced windows. Be sure to measure the parts carefully and use a miter box to cut the wood.

Once your walls are cut out or assembled, it is time to put the building together. If the structure is complicated, with limited access to the inside walls, it is best to do surface texturing and detailing before assembly. For simpler structures you can assemble the walls first. The easiest and most secure assembly method is to peg the parts together with toothpicks. Drill two or three $\frac{1}{16}$ " holes in the

edge of one of the walls and glue half of a round wood toothpick in each one. Trim these pegs to $\frac{1}{4}$ " long and hold the wall in proper relation to the one it is to join. Mark the peg locations in the second wall, and drill $\frac{3}{32}$ " holes. The larger holes will give you some leeway in positioning. Next, glue the walls together and set them aside to dry. If an exact 90 degree angle is important, set the walls in the corner of a box to dry.

Texturing stucco walls. The easiest buildings to model are plaster-covered brick (stucco), and by a happy coincidence these are the most common type found on the European battlefields of WWII. The best material I have found for simulating stucco is acrylic modeling paste, available at art supply stores. Its qualities include nearly perfect texture, adequate working time, and excellent adhesion on a variety of surfaces. Apply the modeling paste with a putty knife, spreading it smoothly. Don't worry about the knife marks, since stucco on real buildings is rarely smooth, but try to eliminate obviously out-of-scale marks. Cracks, patches, and other flaws can be worked into the material while it is still wet, but bullet and

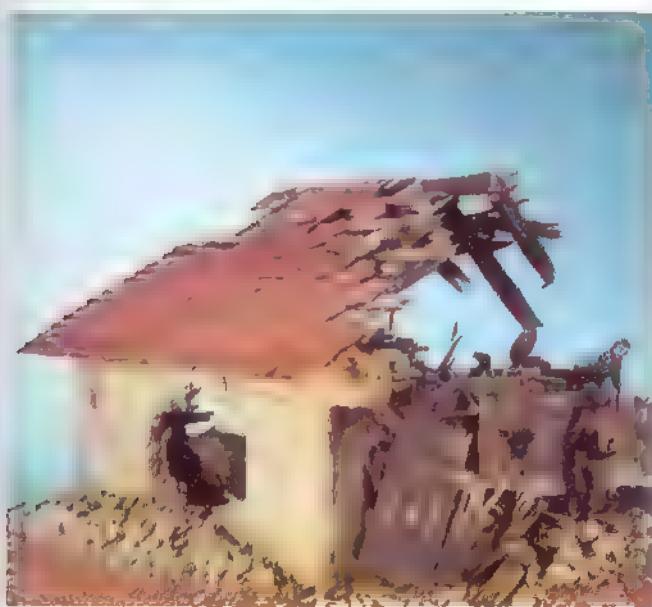
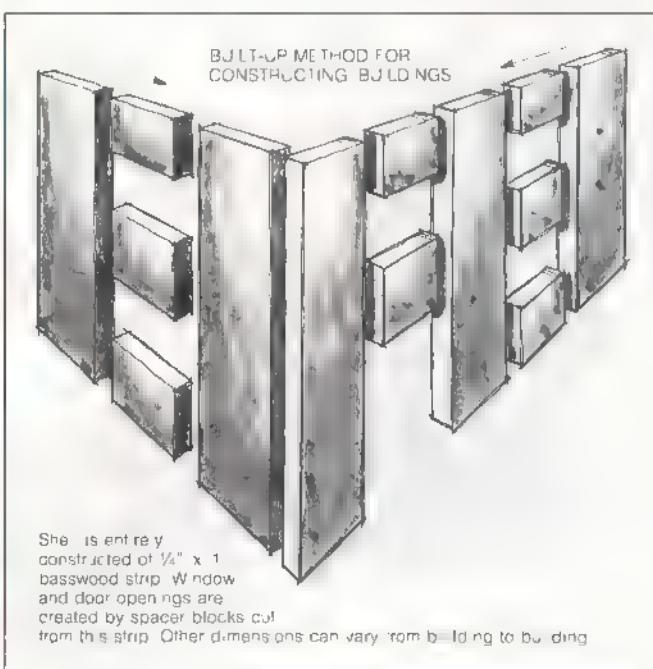
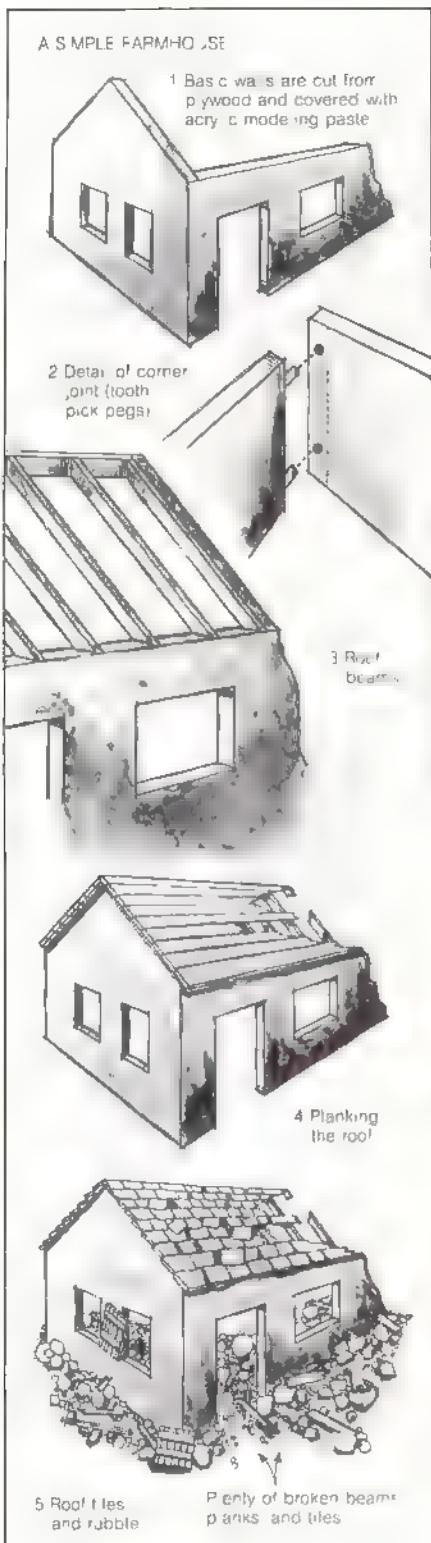


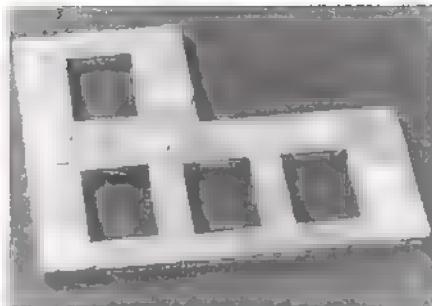
Photo courtesy Monogram Models

A simple farmhouse like this one can be assembled in just two or three evenings, and the results are well worth the effort.





Bullet pockmarks, shrapnel holes, and other superficial damage can be added to stucco walls using a motor tool with a steel cutter or drill.



To model the brick structure behind a stucco-covered wall, add small patches of brick to the plywood wall before applying the stucco texture (acrylic modeling paste) to it.



The farmhouse roof in this scene consists of individual styrene shingles applied over framing and planking made from individual wood strips.

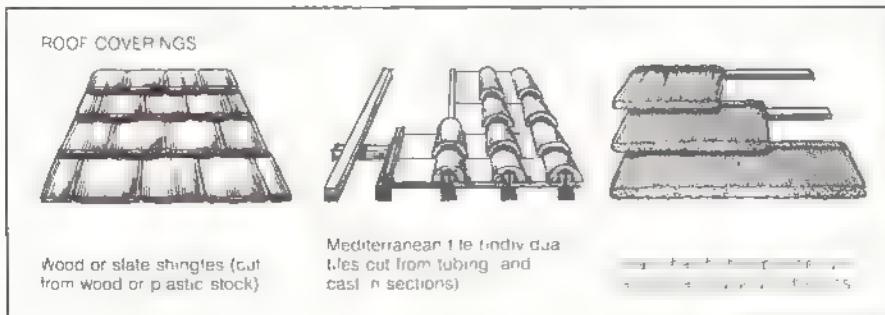


Sharp-eyed modelers will note that there are nails and nail holes in the roof planking on this shattered farmhouse, but that there are no corresponding holes in either the broken or intact terra-cotta tiles, an unfortunate oversight on my part.

Shrapnel holes are best added after the paste has set. To pockmark the dried paste, use a Dremel tool with a drill bit or pointed cutter and simply bounce it at random across the surface.

Peeling and flaking stucco often reveals the brick or stone structure underneath. If you want to include this effect, brick or stone texture must be installed before the stucco is applied. The model railroad department of your hobby shop should have embossed plastic brick and stone sheets. Cut irregular patches and glue them in place on the wall, then apply modeling paste around them, overlapping the edges. All-brick buildings can also be built using embossed plastic sheet, but they involve a lot of work, so much work that they are rarely worth the effort. The brick courses must match at the corners, and each window must be carefully bricked in as well.

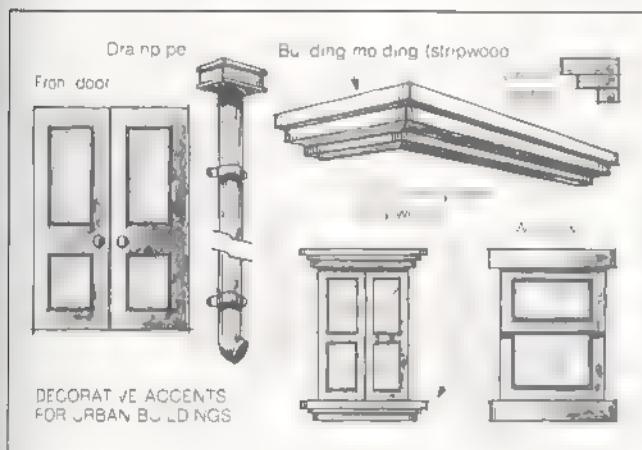
Adding the roof. A real roof usually consists of a timber framework that is planked over and then covered with shingles or tiles to make it waterproof, and the best material for model roof construction is wood. The first step is to prepare the wood by painting or staining it. Brown, gray, or a combination of the two, are good colors for the underside of a barn or shed roof. If you plan to have planks torn away from the beams, leave one side of each beam natural wood color. This surface, hidden by the planking, would not be subject to the same weathering as the exposed timber. Splinter the ends of broken beams and planks before assembly. It is easiest and fastest to create two splintered beams at once by breaking one long one in the middle. Heavily score the area to be broken with a



The inside of the wrecked farmhouse includes splintered roof beams and bullet-hole detail in the door.



Gutted shells are by far the easiest kind of urban structures to model, particularly when the scene calls for three or four of them. This diorama portrays the Battle of Arnhem.



knife, then snap it apart to make two splintered ends.

Use a T-square and ruler to draw up a plan of the roof beam spacing. Lay the beams in position on this plan and glue the planks across them, leaving gaps where planks have been torn loose or broken. Leave broken pieces hanging, and make sure you have enough pieces left over for rubble. When all beams and planks are assembled, go back over the beams and use a knife to gouge nail holes where planks have been torn loose. A final touch is to add bent nails made from brass wire sticking out of the fallen planks.

The next step is to install tiles or shingles. There are commercial plaster castings of roof tiles available which give an excellent effect for an intact roof, but they are less satisfactory for a shattered structure. When a real tile roof is broken the tiles break loose individually, not in chunks, so the effect of a broken plaster roof casting, while effective at a distance, will lack close-up realism. You can make your own flat tiles or slate or wood shingles fairly easily. Styrene is an excellent

material for this, and a large number of tiles can be made quickly using the scribe and snap method. Each tile should be beveled and chipped around the edges with a Dremel tool, and don't forget to make a few broken ones. All tiles or shingles should be painted terra-cotta or slate gray before installation, and weathering can be done in place.

Complex tile shapes are harder to make, but if you are determined you can cast them in RTV molds using Hydrocal (a hard-setting plaster available in model railroad shops). Make up half a dozen master patterns of the desired design in wood or plastic, then make your RTV mold as described in Chapter 7. If you are ambitious the entire roof can be made up of individual cast tiles, or you can use them to supplement the commercial cast roof sections. You may even want to try gluing a group of your castings together, making a mold of these, then casting your own sections.

Thatched roofs, which were still fairly common in Europe during WWII, were built on the same beam

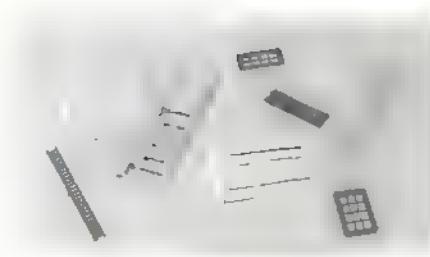


Modeling an urban building that has not been burned out is a lot of work. This Monogram sturmpanzer IV diorama was my first attempt at modeling an urban setting. The iron balcony is a distinctly Mediterranean touch made by connecting the HO balcony railings at the top and bottom with strip styrene verticals.

structure as tiled ones. Instead of planks, horizontal wood batten strips were nailed or lashed to the beams about 2' apart and the thatching was lashed to these battens. The thatch itself is best made with unraveled hemp or crepe hair. If the underside of your roof will not be visible, you can get away with simply gluing the thatch to a sheet of heavy cardboard or plywood. If the underside will be visible, you'll have to install battens, wrap thin cord around them in a loose crisscross pattern, and then glue on the thatch.

To complete your rural building, make doors, shutters, and other wood trim the same way you made roof beams and planking. Stain or paint the wood, glue the pieces together, then add splinters and other details with a knife. Bullet holes are made the same way as nail holes.

Urban and residential buildings. Gutted urban building shells are actually easier than farm buildings because there is nothing to build but the walls, perhaps with some vestiges of flooring. Residential buildings that



This is but a sampling of the hundreds of model railroad architectural details available. You may not always be able to use these in their intended scale or for their original purpose, but they always come in handy for structure modeling.

have suffered only blast damage are another matter. Here the interior walls and contents of the building will all be present, even if they are broken up and rearranged a bit.

The basic construction method for walls is essentially the same as for simple buildings, except that there will be more windows and additional floors. There will be interior walls with doorways from room to room, and if there are additional stories, there will have to be floors for each of these. If the building is in a large city, its architectural details may be elaborate: windows will have sills and eaves, and there will be moldings and other decorative accents. Stripwood window sills, eaves, door framing, and decorative moldings can be added to basic stucco buildings, and the stucco worked around them. Fortunately, neatness is not essential in a shell-damaged building. You will find that pockmarks, bullet holes, and chipped plaster will cover a lot of sins.

If you build urban structures strictly to scale, they will be awfully large. Not only can you get away with making your structures slightly undersize, they will actually look more to scale if you do so, because they will not dwarf the scenes they are supposed to support. When building multistory urban buildings, you can get away

with making each successive story slightly smaller than the one below it until the top story is actually shorter than a man. This ruse works because we are used to looking at buildings from street level, where perspective makes upper stories look smaller. In modeling, the discrepancy in size will only be apparent if we actually hold a figure up to the window. A rule of thumb is that (assuming a 9' ceiling is standard) you can afford to drop one scale foot from the ground floor, and an additional foot from each additional story. This rule holds true for structures up to four stories tall.

Windows and doors. Residential structure windows need more than crude shutters to cover them. Each window opening must be lined with wood, and at least a few should show some vestiges of the window sashes themselves. The model railroad department of your hobby shop has a variety of windows that can be adapted. Look for windows that seem oversize for HO scale. The windows themselves will be too small, but you can cut them diagonally and vertically into fragments that will look like sashes from larger windows. The model railroad windows will have to be glued back to back with clear styrene sandwiched between them so that your windows will be framed on both sides. A substitute for clear styrene is the thin cover glass used for microscope slides. This material has the advantage that you can crack or break it, but the slide covers are very fragile and the broken glass is dangerous, so be careful with them.

Doors, too, require more elaborate construction. Paneled residential doors can be made by cutting the door from thin wood or .040" styrene and gluing strips around the edges to simulate framing. Doorknobs can be made from dressmaker's pins. By the way, most European doors have handles, which is why G.I.'s overseas refer to the U.S. as "the land of the round

doorknobs." Handles can be made from bent wire.

Floors, interior walls, and ceilings. Residential buildings have wooden floors, not dirt ones, and when they are damaged, beams under the floor will be visible. Floors are made in the same manner as the barn roof. If the floor is for an upper story, it requires a ceiling for the room underneath. Such ceilings are plaster over wood lath. The lathing is easy enough to make with stripwood, and the plaster can be simulated with acrylic modeling paste, or, more simply, with index card stock. The latter method is very effective for plaster that is peeling away and hanging in strips. Coat the back of a piece of index card with fine sand, tear a ragged edge, and curl the edge back when you glue the card in place.

Interior walls will also have to be plastered. In rural structures you can get away with plastering and painting simple plywood walls, but city buildings require hollow interior walls. If any of the wall substructure is to be visible, the same plaster and lath method described for ceilings must be used.

Furniture making was discussed in Chapter 7. Urban furnishings should include rugs made from multi-ply tissue or scavenged from a miniature room shop, and curtains made with tissue, mounted on brass wire rods. Pictures on the wall can be cut from magazines and framed with HO windows or Plastruct shapes. The book and record club advertisements seen in magazines are excellent sources for pictures for this purpose.

Rubble, streets, and sidewalks. It takes a lot of bricks, mortar, lumber, and other materials to make a building, and when it all falls to the ground it makes an impressive pile. It is important that a demolished building have enough rubble to justify the damage done to it, so it does not look as if an oversized charwoman has gone in and cleaned the place out. Nothing



These back views of the sturmanzer diorama show how the interior was modeled. The downstairs living room includes curtains, pictures, furniture, rugs, flooring, and floor joists. The



upstairs bedroom includes a scratchbuilt bureau, a family picture taken from a book club ad, and a crucifix made from styrene strips and an N scale railroad brakeman.



A fallen building leaves large piles of rubble, so be sure to include substantial piles around badly damaged structures.

looks more disconcerting than a devastated building with only a few scraps of rubble scattered around it.

The most effective way to make rubble is to take the same material you used to detail the building and break it up. If you used cast masonry, take some reject castings and break them up with a hammer. If you don't have leftover masonry, pour plaster into the bottom of a plastic container, let it set, and shatter it. Another method is to use some of the larger stones in your gravel box. Avoid stones with rounded edges, and stay away from ones that are obviously too large for your wall thickness. Crushed gravel is best. Be sure to throw in some broken beams, planks, and tiles from your roof—that roof had to fall somewhere.

Install your building in its final location on your base, and carefully work Celluclay around it. Sprinkle and scatter the rubble over the diorama in a haphazard manner, pressing the pieces into the wet Celluclay, then sprinkle the whole affair with finer sand and gravel. Finally, overspray everything with a solution of white glue and water, and leave it to dry overnight. If the drying takes too long, you can hasten it with a heat lamp.

Urban boulevards, unlike country dirt roads, are paved, and have sidewalks, curbs, and gutters. There will also be manhole covers and drains, street lamps, and signs. Asphalt streets are made the same way as runways (Chapter 3), and sidewalks can be added with $\frac{1}{4}$ "-thick basswood or plywood. Scribe in concrete panels and curbstones, and add nicks, cracks, and other scars of day-to-day living or recent warfare.

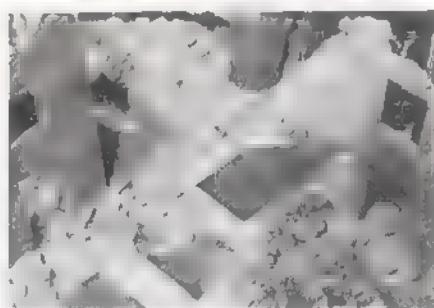
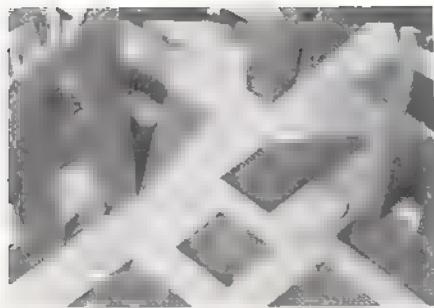
Cobblestone streets can be made using HO model railroad fieldstone textured building sheet. Remember to make the "grain" run across the street, not along it. This often means using



Even when you use commercially available accessories, take the time to customize them. This realistic battered lamp post in Dave Smith's Tiger II diorama is an excellent example of a commercial part combined with a bit of extra work.

several sections, carefully camouflaging the seams between them. When a scene involves damaged buildings, you can cover most of the street with rubble, leaving only patches of cobblestone showing through. Be sure, however, that it looks like patches of cobblestone showing through, not rubble sprinkled along the seams between cobblestone sections!

Manhole covers can be cut from styrene and detailed with concentric rings by mounting the plastic disk in a motor tool and scoring the face with a file as it spins. Gutter drains are harder. You must first chisel a square hole out of the gutter, then paint it



This photo sequence shows the steps in building a rubble-covered cobblestone street. First, the cobblestone sections are positioned in the street. Then, Celluclay is applied over and around the stone sections to form the basic shapes of the rubble piles. Next, gravel and pebbles are applied over the Celluclay, and finally, sand and rubble are spread over the rest of the street, leaving only a few patches of realistic cobblestone texture showing through the debris.

black before covering it with a styrene strip grille.

Wood and stone structures. Trees are a precious commodity in Western Europe and wooden buildings are rare, but this is not the case in Russia or the United States, where forests provide timber in abundance. Models of wooden buildings are constructed almost exactly like real frame structures

A framework of beams is built first, then covered with plank siding. This construction is largely a matter of expanding the techniques described for building a roof. Wooden building construction is covered in great detail in model railroad books, and the methods described for HO structures can easily be used for larger scales.

A wooden building is a time-consuming project, one I avoid unless the theme of the diorama specifically calls for it. Before construction, a full-size plan for the model must be drawn up on cardboard. Then, wooden spacer blocks and other locating devices are glued to the plan so that the framing pieces can be cut and positioned on top of the plan. The plan forms an assembly jig, and the frame is constructed and glued together right over it. When all the frames are assembled, they are removed from the jigs and assembled. This forms the shell of the building, and the siding can then be glued over the framework.

Stone buildings add variety to your structures, whether they are rough farm buildings or fine masonry on a city block. Natural stone structures can be made using a mosaic method. You will need a lot of pebbles, so gather them ahead of time. The walls are cut from plywood, using thinner wood than usual. Pebbles are then glued to the surface with white glue. When the glue has set, apply standard tile grout over the pebbles to represent mortar. When the grout has set, follow the instructions provided to scrub away the surface grout, revealing the pebbles.

Cut-stone buildings are more time-consuming. Make the walls from plywood, and either cut grooves in the plywood surface or apply individual stripwood stones over it. Bevel the edges of each stone before gluing it in place. For more ornate stones, make one or two original patterns and then

cast as many as you need in an RTV mold. You may want to use your first castings as patterns for a multiple mold, or even make a mold of a group of stones glued together to form an entire wall section. This casting technique is by far the best method if your building is to be badly damaged. Instead of casting thin veneer-like stone sections, cast full thickness blocks. Then assemble the blocks to form the wall, or what's left of it, and break more blocks to scatter around as rubble.

Weathering structures. Painting buildings is easier than painting vehicles, because you can make use of several techniques and apply them with a broader brush and a coarser touch. Stucco and stone surfaces can be weathered with a combination of washes and dry-brushing. I usually paint my buildings first with hobby paints, then follow with a wash of Polly S, thinned with denatured alcohol. Apply the wash liberally, then wipe it off with a rag, leaving color in the recesses. Then dry-brush the surface, first with a lighter version of the wall color, then with dusty tans and browns. Additional washes can be applied to tone down harsh dry-brush effects and to add subtle variety to the coloring. Finally, fresh bullet holes and pockmarks should be touched in with light tan or white, but older scars left dark.

To paint brick, first spray the walls with a uniform dull red (boxcar red is ideal), then apply a wash of Polly S gray and wipe it off, leaving the gray in the mortar lines between the bricks. Dry-brush irregularly with red and orange to vary the brick colors, then apply a brown wash. Add fresh bullet holes and pockmarks with a bright pinkish red.

While newly painted wood surfaces can be treated much like the materials and surfaces already mentioned, bare

weathered wood is more time-consuming. Start by scribing and scoring the surface. Knotholes can be made either by pushing the scribe into the surface, or by drilling a hole. For knots that are still in place, scribe a small circle or oval into the surface of the wood, or press it in with the end of a brass tube. Do the knots first, then scribe in the grain, flowing the grain lines around the knots. Use your knife to splinter board ends and split some of the boards.

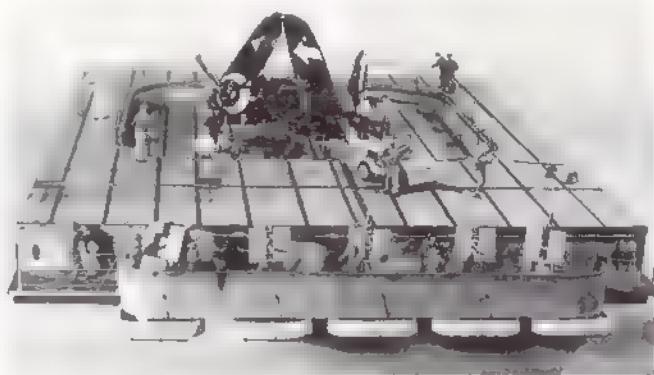
Stain the wood first with a driftwood gray, then streak with browns by just touching the brush to the surface and allowing the cuts and splits to carry the stain in a natural manner. Fresh splits should be left a natural wood color, or toned down with a tan or maple stain. Flo-Stain wood stains made by Floquil yield good results, but in a pinch you can mix up washes from any paint. Try staining at various stages during the scribing and splitting process. Finally, lightly dry-brush with gray, brown, or both. The rubber cement masking technique used for simulating peeling paint on aircraft (Chapter 9) works well on both wood and stucco walls.

In this chapter, emphasis has been on techniques, but before closing, I'd like to talk about designing the buildings themselves. Structures offer you the greatest freedom of design of any of the elements in your diorama, and it's a shame to let such an opportunity go to waste. A tank or airplane must look like its original, but a building can look like any of thousands of different types and styles seen in a particular theater of operations. Go through your reference library, looking not for military hardware but for the architectural styles of the buildings in the background. When you spot something unusual, make a note of it for future reference.



Both photos: Kammer Books Mike

Ron Volstad came up with this novel approach to modeling intact buildings in his Italian Campaign diorama. The building facades are only about an inch deep and are mounted against a board which forms part of the base.



The basic structure of this aircraft carrier deck scene by Ron Clark is wood, covered with basswood deck planking. Ron used thin sheet plastic to simulate metal surfaces. The Oerlikon guns are commercial metal castings by H-R Products, and the figures are conversions from Airfix multi-pose kits. The fire extinguishers, life rafts, and shipboard plumbing account for much of the authentic shipboard atmosphere.



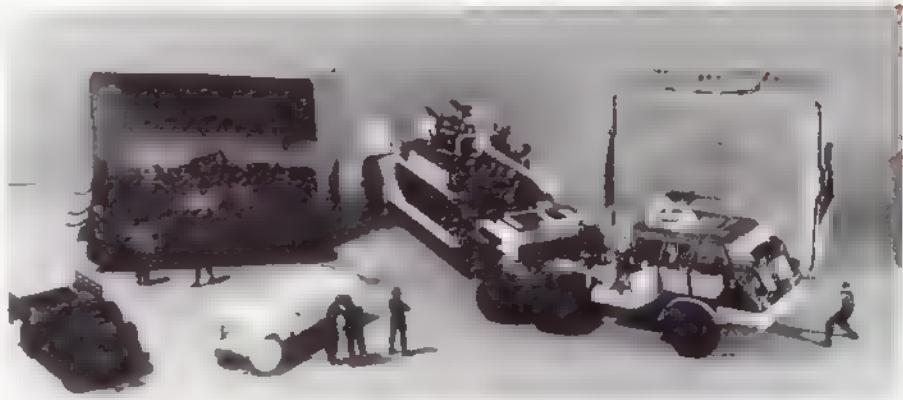
11 Step-by-step

The road to Damascus

This diorama depicts a typical moment toward the end of the Yom Kippur War of 1973. Shown is an intersection in Quneitra, the principal Syrian city in the Golan region. The town, abandoned since the 1967 war, was recaptured by the Syrians during the first few days of fighting, then overrun once more by the Israelis during their counteroffensive. By the end of that counteroffensive, the Israeli armored forces were within striking distance of Damascus, and Quneitra was in the wake of the Israeli advance.

The Israelis are famous for their practice of scavenging battlefields, and they salvage absolutely anything that might be of value. In this scene, a damaged M-51 Sherman tank is being transported back to the depot on an M-86 armored tank transporter and recovery vehicle. Like the Sherman, the transporter is a rebuilt American relic of WWII. The Israeli "super Shermans" are remarkable tanks Up-gunned with an awesome French 105mm gun and powered by a 500-h.p. diesel, these 30-year veterans were able to hold their own against Syrian T-62's, then the latest tank in the Soviet arsenal.

Although the scene is set before the arrival of the United Nations peace-keeping forces on the Syrian front, the UN had maintained observer teams

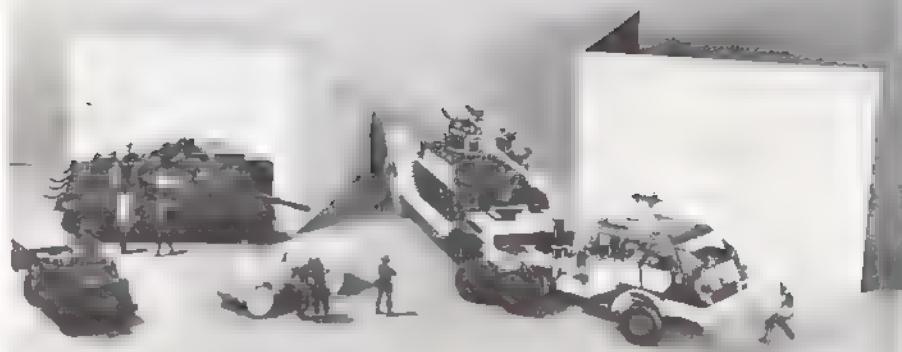
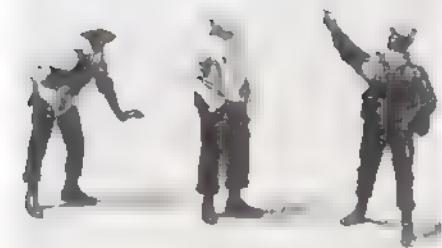


This is the initial planning layout, with boxes representing the buildings. The vehicles and buildings were positioned first, then the figures were posed to fit, one by one. Until well into the construction phase of this project, I had considerable doubts as to whether this many vehicles could be integrated into a scene of reasonable size without looking like a parking lot. The layout was constantly checked and analyzed as the vehicles were constructed.

in the Middle East since 1948, and one of these units is seen watching the proceedings. Their white Land Rover and famous blue berets provide the only touches of bright color in the diorama.

This diorama is a good example of a project that, like Topsy, "just sorta growed." The tank transporter, the centerpiece of the scene, did not figure in the original design at all. I have always been fascinated by the souped-up Sherman tanks used by the Israeli

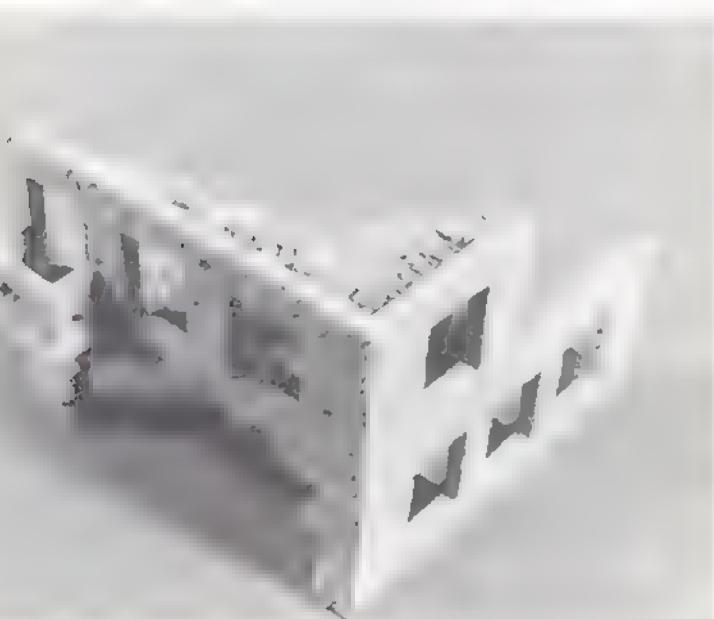
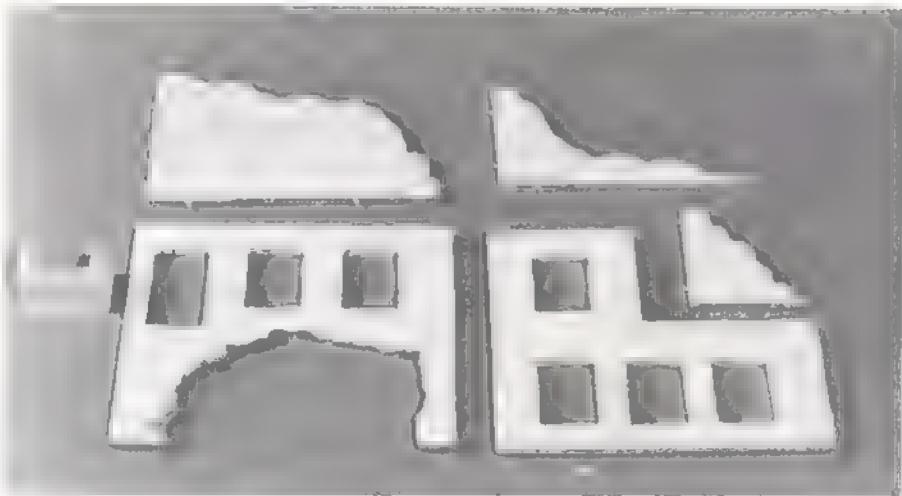
army. My original concept was to do a scene of such a Sherman replenishing ammunition in an Arab town, but when I saw the kit of the tank transporter in a hobby shop, I realized I had to include it. Including the transporter meant eliminating the ammo idea, and posing the transporter in the act of negotiating a difficult corner developed instead. The knocked-out T-62, the Israeli weapons carrier, and the U.N. Land Rover were added as planning progressed.



Cardboard mock-ups were made to establish the exact designs and dimensions for the buildings. The Max tank transporter was extensively rebuilt with parts from a Life-Like Atomic Cannon, Monogram 1/24 scale Mack truck, and Monogram M-8 armored car. The Sherman was built using the hull and turret from an Italaeri-Testors M4A1 and the suspension from a Tamiya M4A3E8. The big 105mm gun was built up from telescoping brass tubing, epoxy putty, and sheet styrene. The other vehicles in the scene were built, with minor modifications, straight from the box.

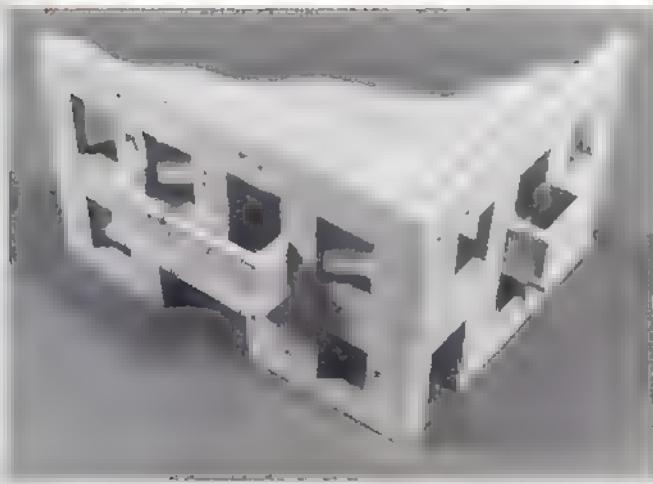
The figures are all Tamiya, taken primarily from the British stretcher party, modern U.S. command set, and various U.S. WWII sets. Most have been converted to a new pose. During the 1973 war, the Israelis frequently wore their shirttails out, and this detail was added with epoxy putty. The net texture on the helmet covers was achieved by covering the helmet with putty and pressing it with an old T-shirt. In these photos, two figures are missing. The ground guide in the center of the diorama and the fellow munching a matzo were last-minute additions.

The parts for the smaller of the two buildings. The walls were cut from $\frac{3}{8}$ " plywood and covered with acrylic modeling paste. Note the toothpick pegs.

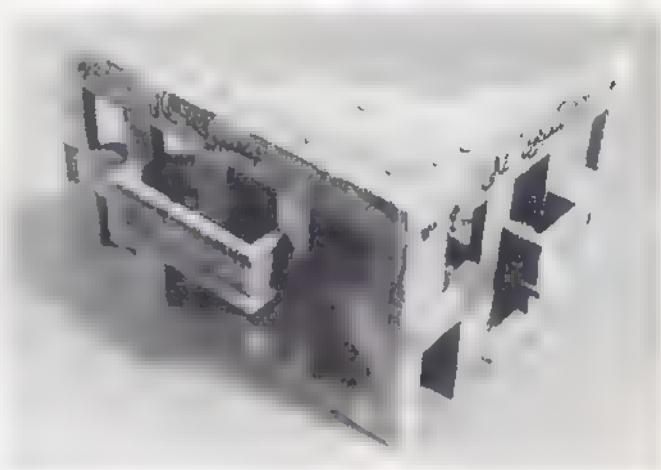


The assembled building. Shrapnel marks from several wars have been added and the building sprayed tan overall. Rubble

has been added to the floors and roof and glued in place with a generous overspray of diluted white glue.



Construction of the larger building is identical. After assembling and texturing the walls and painting them light tan, a dark brown wash was applied, then wiped off where necessary with a tissue. The entire surface was dry-brushed with several shades of tan, and Arabic lettering applied to the walls. The buildings in the Golan region had been abandoned since the Six-Day War, so there would be little left of the furnishings.



The finished buildings in place on the diorama base, with landscaping completed. The sand in northern Palestine is distinctly gray, accounting for the grayish tan colors used on Israeli armor.



The extensively rebuilt transporter and Sherman after weathering.



The completed Sherman. Notice the enormous size of the gun, which is, believe it or not, in scale. I am told that when the gun is fired, the crews frequently put the transmission in neutral and let the whole tank absorb the recoil! Stowage bins on the side are sheet styrene, and the searchlight is a spare road wheel covered with sheet styrene. Also noteworthy are the tissue mantlet cover, smoke grenade launchers (brass tube), and unusual jerry cans, which are black rubber and have only one handle.

The tactical signs and telephone poles were not part of the original design. When all of the planned elements were in place, something was still missing, and the signs added the needed spark to the scene.

The road signs are provided here actual diorama size. I made originals using rubber on Hebrew lettering. These were photostated down to the correct size at a blueprint shop, then the signs were cut out, glued to plastic sheet, and weathered with pastels.

פיקון תותחים תחנת רפבת

Ordnance
repair depot

תחנת טקלחת

Shower point



חדר מטבח

Graves registration

קצין דיאט חייט

Battalion supply officer

מחנן

Commissary

צודח דאשונז תחנת נזירות

Medical aid post

קצין תחנת נזירות

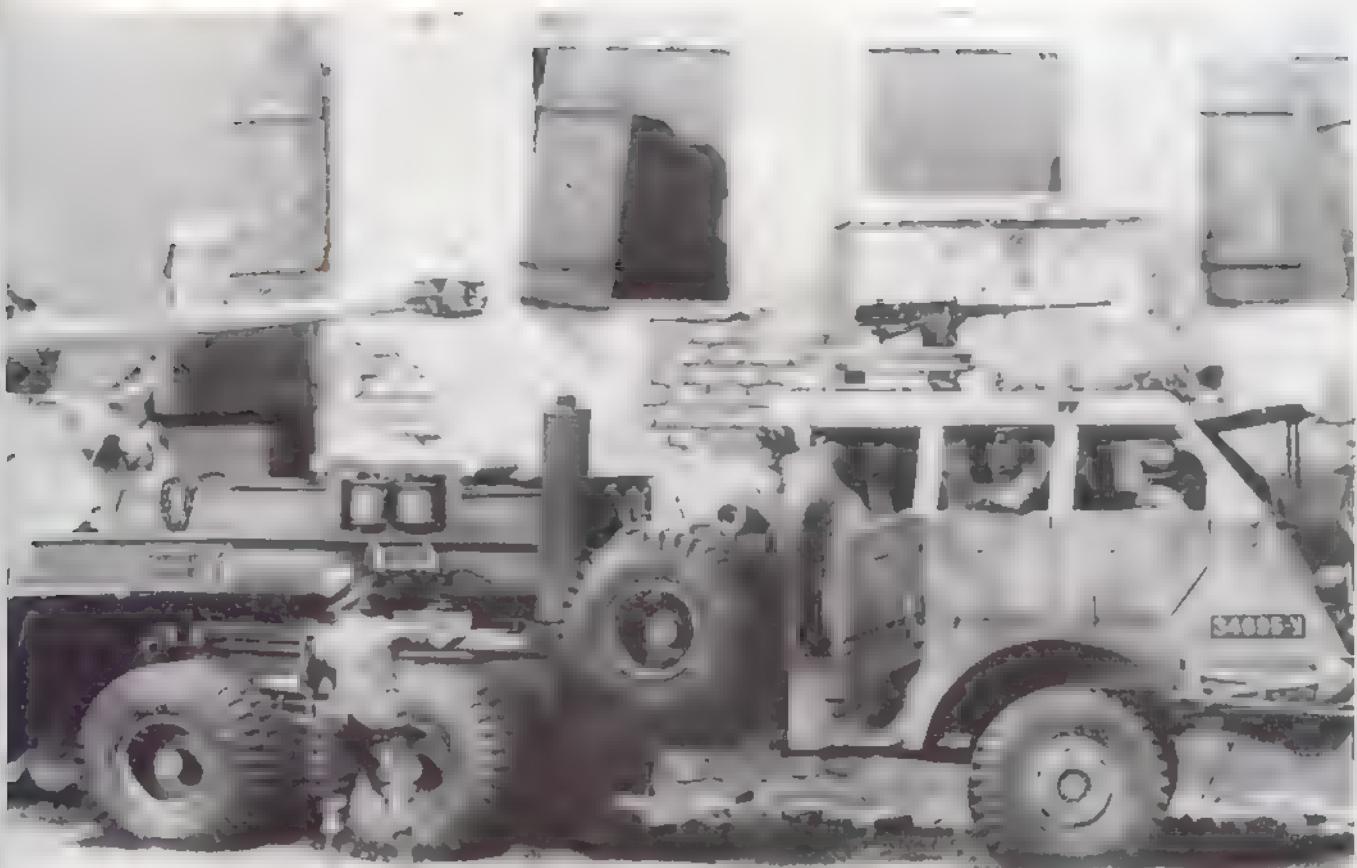
Officer's latrine

Battalion rear
reception center

תחנה ביהוד חייט

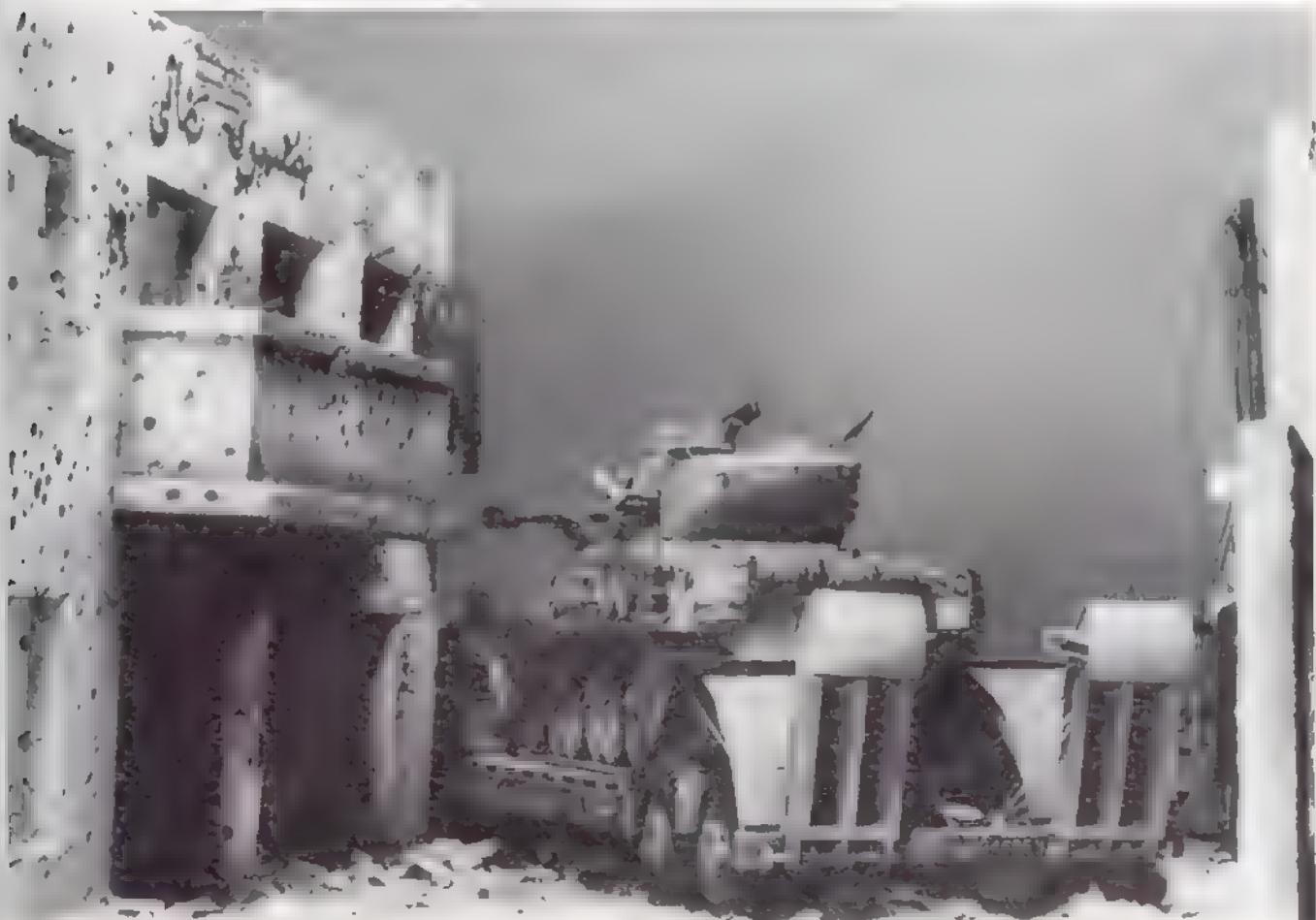
בזמר מלכויות

Chaplain



Note the winch rollers on the front of the trailer, and the yarmulke on the crewman (during the Yom Kippur War, many soldiers wore them as a sign of faith). The shutters were added

at the last minute because the buildings looked too plain, and a touch of color was needed. One pattern was made, and the rest were cast in Tuf-fil/polyester.





Placing figures in conversational groups like this is an effective design device. The downed power lines are black thread, stiffened in place with white glue. An important final touch is the way the ground color is carried up onto the vehicles and boots

of the figures. This is partly the way they were painted, but also a result of a final application of pastels after the figures were glued in place. This is important, because it gives the diorama visual unity that might otherwise be lost.





"The Gun Deck of HMS Victory at Trafalgar" shows why the shadow box is the ultimate form of diorama. The dramatic effects possible when the viewpoint is restricted and the lighting is controlled simply cannot be achieved in an open scene. The scratchbuilt 1/18 scale scene has mirrors at each end to provide the illusion of a full-length gun deck.

12

Shadow boxes



Ro and Pa. erso

A shadow box is a diorama set into a box and viewed through an opening in one side, and its effect is essentially that of a three-dimensional painting. In many ways, the shadow box is the ultimate form of the diorama. This is because of the degree of control over all aspects of the display that a shadow box affords the modeler. In a shadow box you can dictate the viewing angle, lighting conditions, and, most important, the atmosphere and mood of the scene.

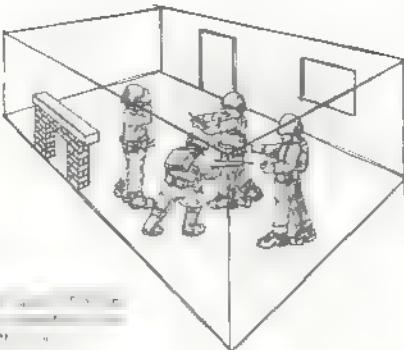
Because it is contained in a box, a shadow box must have its own lighting system, a requirement that is both an awful nuisance and a golden opportunity. A certain working knowledge of electricity is essential in building shadow boxes, but you need not be an

This shadow box diorama by Ray Anderson of California depicts the violin shop of Antonius Stradivarius. Note the professional finish of the outer case and the front frame

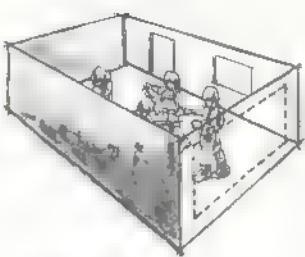
PLANNING A SHADOW BOX



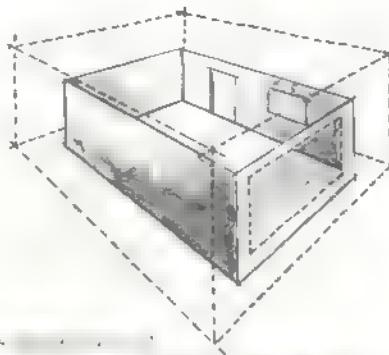
1 Design from the inside. First arrange the figures.



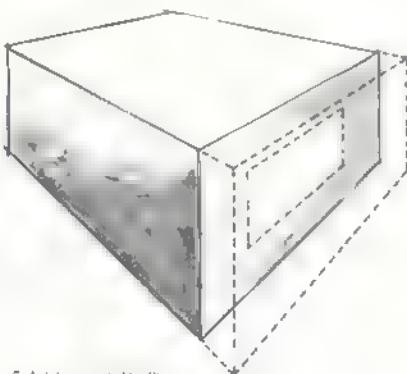
2 Sketch the scene to determine the size of the viewing window.



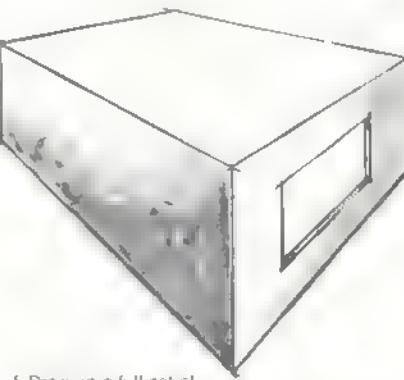
3 Next, determine the size of the viewing window.



Extra room is needed. This establishes the outer frame.



5 Add space for the outer frame, if any.



6 Draw up a full set of plans as a guide to start building.

electronics expert. The small-time electrical system in a diorama is strictly kindergarten level when compared to even the simplest model railroad layout.

Planning a shadow box. Building a shadow box is a lot more work than other dioramas, especially if you spend time backtracking to correct mistakes. A shadow box scene involves several disparate elements, each of which must be constructed separately and coordinated to fit into the final display. Careful planning is a most important step, and can save you a lot of headaches later on.

The first step is to ensure that your subject is workable in the shadow box format. Shadow boxes lend themselves most readily to enclosed settings. Wide-open outdoor scenes are possible and have been done well, but they require not only the ability to paint a

realistic backdrop, but also the means to blend that painted backdrop with the three-dimensional foreground. If you're just starting out, limit yourself to scenes that are set indoors or in locations surrounded by walls, trees, or other enclosing devices.

Make sure that your topic is suited to a single viewpoint. Subjects with a lot of detail or a hopelessly obstructed view of the main event require all-around viewing for the scene to be effective. Don't fall into the trap of confining such a scene to a shadow box just because you feel like building a box.

A shadow box is best planned from the inside out. Start by arranging your figures. Check out different arrangements and viewing angles to determine which of the possibilities you like the best. Once the final figure arrangement is set, lay out the scene around it.

Next, decide on the sizes of your viewing window and borders. Make sure that the viewing aperture is not too small for the box (a border of 2"-4" is best, anything over that usually includes wasted space) and that the scene inside will be compatible with the "apparent value" of the box. A big box calls for a big scene.

The overall size of the shadow box has a lot to do with the size of the border around the viewing window. The exact size of your border is usually dictated by the side of the scene that needs more space than the others. For example, in a scene with a high ceiling, the wide border needed to mask this element will be what determines the dimensions of the other three. Likewise, a scene in which a room is canted at an angle rather than viewed straight on requires a wide border on one side. For a simple, straight-on scene the only border width requirement might be the 2" clearance needed underneath to accommodate the lighting transformer. Your shadow boxes will be more attractive and have more of a picture effect if the viewing aperture is centered on the front of the box, with an equal border all the way around. You can occasionally get away with making the bottom border $\frac{1}{2}$ " wider than the others, but I would not carry it any further than that.

Now draw up a complete set of plans for your scene. Start with rough sketches less than actual size, but make the final detailed set of drawings the same size as your model. These drawings don't have to be beautiful, just detailed. Draw up an overall top view of your shadow box, a side view, and a front view. Take the time to work up actual size drawings of each interior wall, including all details. Drawing these plans actual size gives you a feel for the project, and allows you to transfer measurements directly from the plan to the model, saving time and possible errors.

When the drawings are done, check them carefully. Plot sight lines from the edges of the viewing aperture to ensure that the viewer cannot accidentally see what he is not meant to see. Make sure that you have allowed enough room for light fixtures, and that these will not be visible. Other practical problems will still turn up during construction, but the more of them you can eliminate at this stage, the easier the later going will be.

Constructing the scene. The shadow box is also built from the inside out. Build the scene first, saving the outer case for last. This way you are free to make changes as construction progresses. The scene itself should be built on a simple plywood shelf that can slide in and out of the case. This arrangement allows full access to the modelwork during construction, and



The diorama scene for "The Death of Jim Bowie" (page 93), removed from its outer case. Note how little space there is at the

edges of the scene, and how most of the electrical equipment has been mounted underneath to keep it readily accessible.



Shadow boxes call for considerable planning. Left, the interior of my 1/18 scale HMS Victory before adding figures, and right, the plans that I drew up before construction.

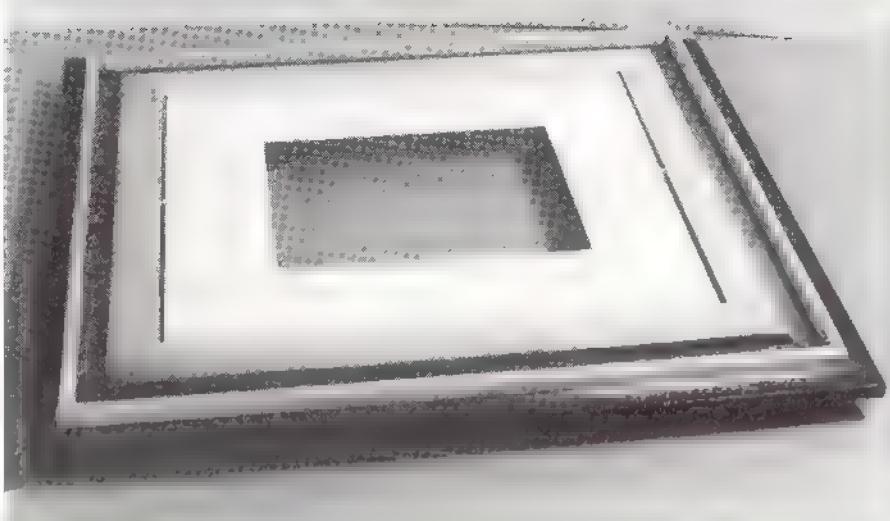
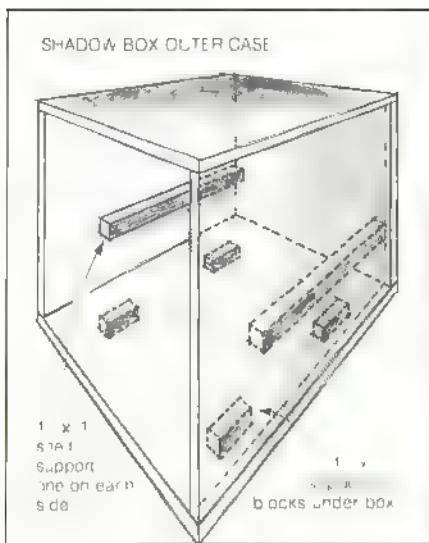
ease of repair when it is completed. Other than the sliding shelf, the scene is constructed just like any other diorama, except for one cardinal rule: *Don't waste time on what can't be seen.* This means painting only the visible sides of figures and accessories. This rule is the great timesaver that makes up for the time devoted to the other aspects of the shadow box.

Building the case. The case is the frame that sets off your scene, so you want it to be attractive, but not ostentatious. Unless you are a skilled cabinetmaker, you also want it to be easy to build.

The sturdiest material for the case is plywood— $\frac{1}{4}$ " plywood is sufficient for all but the largest boxes (those more than 24" high, wide, or deep), which may require $\frac{3}{8}$ " material. The basic shell of the box is constructed as shown in the drawing. Again, draw up a plan and figure out exact dimensions for each piece, compensating where necessary for the thickness of the adjoining sides. Nail the box together with small brads, and glue reinforcing strips into the inside corners. The nails should be set and the holes filled with putty. Fill all seams and surface flaws and sand the exterior of the box smooth.

The outside of the case can be finished in a number of ways. One popular covering is self-adhesive vinyl, and many modelers use walnut wood grain vinyl. I find it easier (and a little less "plastic") to simply paint the entire box an unobtrusive gloss black, both inside and out. A final touch is to attach four small supporting blocks to the bottom of the box to raise it about 1" from table level.

Only a few fittings are required inside the case. A 1" x 1" rail should be glued to the left and right inside walls to support the scene. A $\frac{1}{4}$ " hole should be drilled at the bottom back for



the main power cord, and a larger ($\frac{1}{2}$ " or $\frac{3}{8}$ ") hole drilled near the front for the on-off switch. If you are going to use plug-in electrical connections, you will need a simple wood mounting plate for the required plugs. Finally, you will have to drill mounting holes for the lighting transformer.

Don't worry if your first shadow box case is less than a masterpiece. Your carpentry skills will improve with practice, and there is more than a little truth to the rationalization that if the viewer spends all his time noticing flaws in the case, the scene inside must be pretty dull to begin with!

The frame. The next step in preparing the case is the frame. Don't try to make this at home; invest in a custom frame, or go to a frame-it-yourself shop

The back of this completed shadow box frame shows the short toothpick pegs that retain the mat and glass, and the mat itself. The square basswood strips on the back of the frame were added around the edge to make the frame a snug press fit into the front of the box. Screws to hold the frame are then optional.

and build your own. You will want the inner frame mat board to show, but not much of it; about 2" is generally the limit. The area covered by the mat can be reduced by choosing a fairly wide frame and using a fabric-covered liner.

You can cut the frame mat yourself if you have a mat cutter, or you can have the frame shop do it. They won't charge much to cut a mat for you, and they will probably do a better job. Have the glass cut at the same time. I always put the glass behind the mat, but it can be done the other way around just as easily. Drill holes around the inner edge of the frame and insert toothpick pegs to hold the mat and glass in place. This arrangement allows both the mat and glass to be removed for cleaning or replacement.

The back of the frame should have a ridge or rim that is a force fit into the front of the case. Some frames include such a ridge as part of the molding, in which case you can order the frame custom-made to an exact fit. Otherwise, glue strips of $\frac{1}{2}$ " square basswood to the back of the frame to make the ridge. This ridge has several advantages. First, it allows you to install and remove the frame quickly while you are working; second, it prevents light from escaping around the edges of the frame, and third, it can easily be secured with small screws at either side of the case.

You may want to install an inner frame, called a "reveal," as well. This device allows you to set the scene back further into the box, which will cut down on room light spilling into the scene (an important consideration for night scenes) and give the viewer some focusing distance between himself and the models. The reveal also provides a convenient place to mount lights,

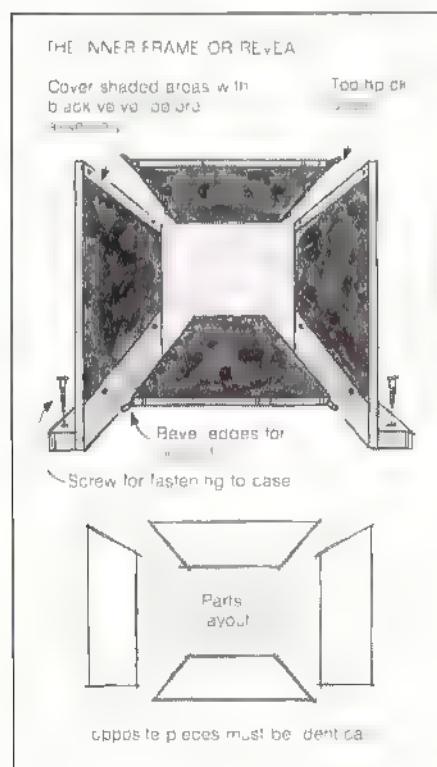
allowing you to illuminate the scene from an oblique angle while casting light on the front of the figures.

The inner frame is basically a square funnel, narrow at the scene end and growing wider as it nears the frame. The narrow end should be the same size as the opening in the mat, and the other end about 2" wider on each side.

To build the reveal, draw up a plan to establish your measurements and construct the frame as shown in the drawing. The edges where the top and bottom contact the sides should be beveled as shown. Opposite pieces must be exactly the same size and shape, and positioned at exactly the same angle. The reveal is held together with toothpick pegs in much the same manner as the buildings described in Chapter 10.

Before assembly, the four pieces should be covered with velvet. Velour paper will do, but velvet fabric is better. I use black velvet because it remains totally neutral even when exposed to direct light, but other colors might work just as well. Cut the velvet to size allowing for an overlapping flap on the inside edge, and glue in place with spray adhesive or white glue. Since it is important that all visible surfaces be covered, glue the material in place slightly oversize, then trim it with a knife after the glue has set. Next, apply glue to the joints and assemble the reveal. Use a stack of books on either side of the frame to hold it in position, and make sure that the opening on the frame is exactly square. Let it dry overnight.

When the inner frame is ready, position it inside the case to check the fit in relation to the scene. Blocks can be glued to the bottom of the inner frame so it can be screwed to the



bottom of the case, or simple retaining blocks can be glued to the case to hold the reveal in position.

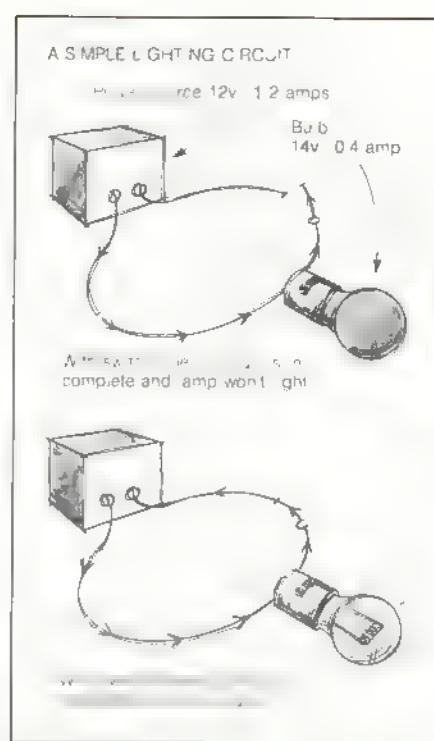
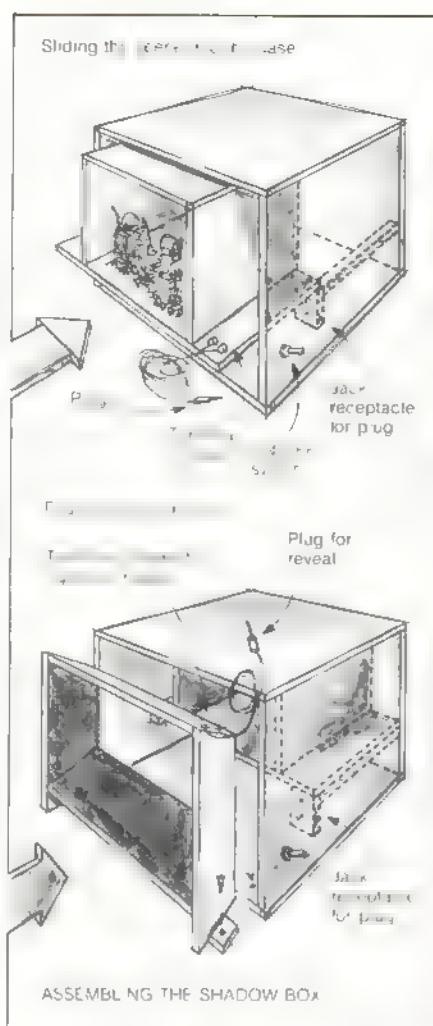
Lighting system basics. This is the subject that most frightens would-be shadow box builders. Fortunately, the knowledge you need is so specialized that it is very limited in scope. Shadow box lighting systems are simple.

Although there are a number of lighting systems that could be used for dioramas, I prefer a 12-volt system for a number of reasons. First, 12-volt bulbs can provide lots of illumination without generating appreciable heat. Second, the low voltage makes the system safe to use; short circuits might smoke and scare you a bit, but they won't electrocute you. Third, 12-volt systems are standard in model railroads, miniature rooms, and full-size automobiles, giving you an extremely wide range of miniature lamps and fixtures to choose from.

Let's look at a simple 12-volt lighting system that consists of a power source, an on-off switch, and a lamp. Current flows from the power source, through the lamp, and through the switch, back to the power source. When the switch is on, the circuit is complete and the current flows, lighting the lamp. When the switch is off, the circuit is interrupted and the flow stops. Note that it doesn't matter whether the switch is before or after the lamp in the system; the circuit must be complete for the system to work. Don't worry, incidentally, about the direction of the current flow; this makes a difference in motors, but is immaterial with lamps.

In our example, the power source (a transformer) is rated at 12 volts and 1.2 amperes, and the light bulb is rated at 14 volts and 0.4 amp. Since the power source supplies only 12 volts, the lamp will not burn quite as bright as it would at its full rating of 14 volts, but it will last longer. Since the one bulb draws only one-third of the current produced by the power source, two other bulbs can be added to the circuit. Then, three bulbs at 0.4 amp each will match the output of the 1.2-amp transformer. Additional bulbs (beyond three) would require more current than the power source is capable of providing, and the transformer would burn out.

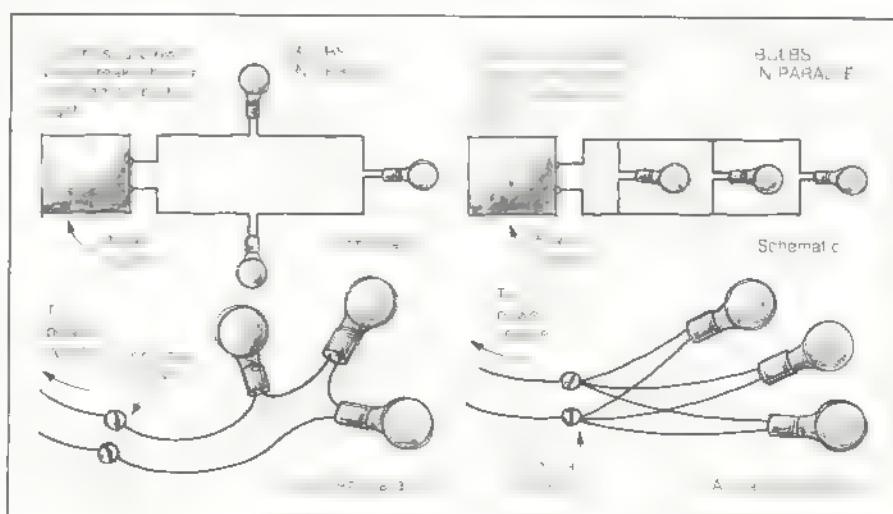
Now that we have three bulbs in our system, burning at 12 volts, each drawing 0.4 amp, let's diagram the circuit. There are two ways to connect the bulbs in the system and still have a complete circuit. The first is to connect them in series, so that the current flows from one bulb to the next and back to the power source. This is a workable system, but it has an important practical drawback. If one bulb burns out, it interrupts the circuit, extinguishing all the bulbs, and the

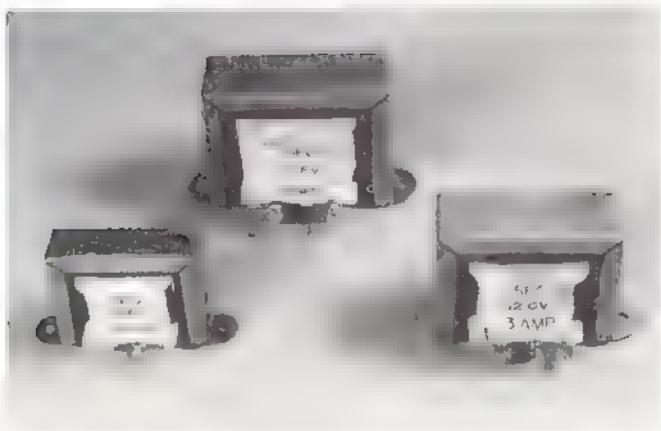


only way to find the culprit is to exchange each bulb until all the bulbs light again. A better method is to connect the lamps in parallel. In a parallel system each bulb has its own circuit to the power source, so if one burns out, the others are not affected.

Components. First, you will need a 12-volt power source. The most convenient source of this type is a transformer, which converts standard 115-volt household current to 12 volts. Trans-

A shadow box inner frame (also called a reveal), showing wiring terminals for the lighting system (upper left) and a jack plug to connect to the rest of the system.



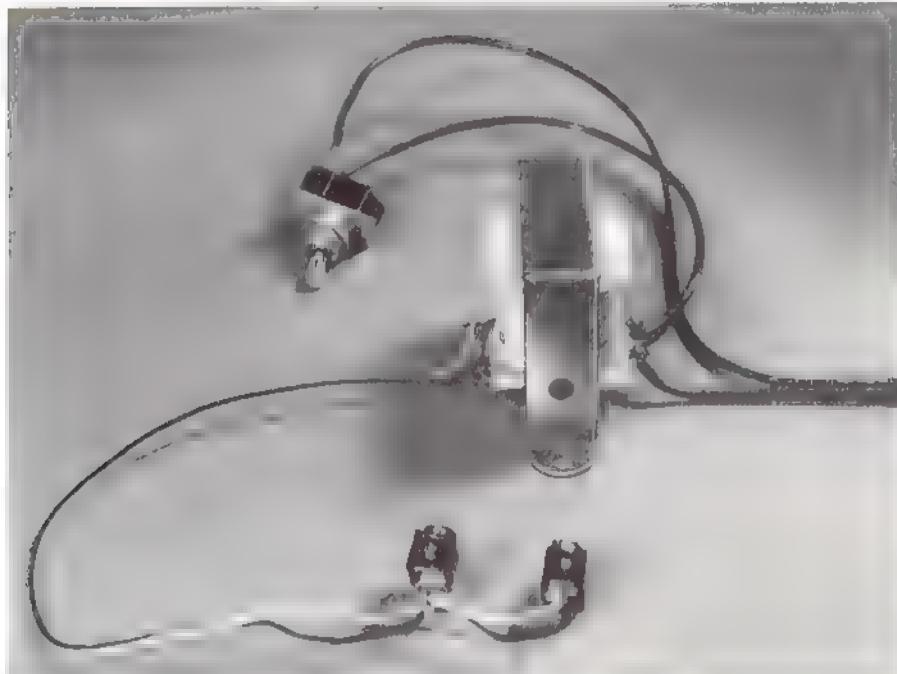


LAMP	SOCKET	CANDLE- P WFM	AMPS	VOLTS	FT H H
CM 1814	min bay	4	.1	12	200
CM 57	min bay	2	.1	12	50
GE 89	auto bay	6	.04	12	5
GE 9	auto bay	4	.04	12	5
GE 1003	auto bay	12	.04	12	5
GE 1156	auto bay	30	.04	12	5
GE 1196	auto bay	100	.04	12	50

CM - Chicago Miniature Light
GE - General Electric
Code number of bulbs is generally the same from manufacturer to manufacturer.

USEFUL BULBS FOR SHADOW BOXES

These transformers are typical of the type used for shadow box lighting. The ampere figure marked on each transformer is its maximum rated output.



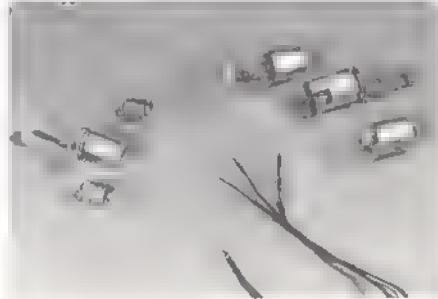
A typical transformer, on-off switch, and jack installation.

formers are available at Radio Shack or any electronics supply store, the usual ratings are 1.2 amps, 3 amps, and 5 amps. To determine which transformer rating you need, add up the ampere ratings of your lamps and make sure that they do not total more than the rating of the transformer.

There are hundreds of bulbs and several types of lamp sockets for you to choose from. There are three basic types of bulbs. The most familiar has a miniature screw-in socket, and comes in several sizes. The second type is the bayonet-base in which the bulb is pushed and turned into the socket. Very small bulbs simply have two wire leads and do not use a socket. I use the bayonet-base sockets and bulbs most often, because there are only two standard sizes and I can fit all of the bulbs I usually use into one or the other. Miniature bulb sockets usually are not rated as to volts or amps, so a given socket will do as well for a 3-volt bulb as for a 12-volt bulb.

The table lists the bulbs I have found most useful in shadow boxes. I have omitted grain-of-wheat and smaller bulbs because they vary so widely in size and ratings, even from one bulb to the next. You can generally figure a current requirement of .08 amp for a grain-of-wheat bulb. Candlepower is a measure of the brightness of the light. You will notice that not all bulbs are rated at exactly 12 volts. A 14-volt bulb is actually preferable, because even though it will not burn at quite its full brightness, the voltage "cushion" will double or triple its expected life.

Shadow box lighting installation. Now let's install a lighting system in a shadow box. The best way to keep track of what you are doing is to start at the wall plug and work your way through, step by step. The tools you will need are a wire stripper, pliers, and a screwdriver. A soldering iron is also recommended, but not absolutely necessary. While you can mount the components in the box as you go, it is often easier to



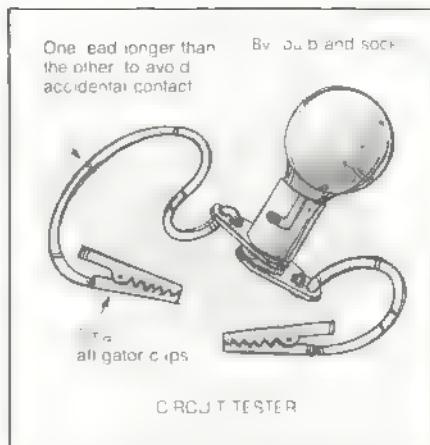
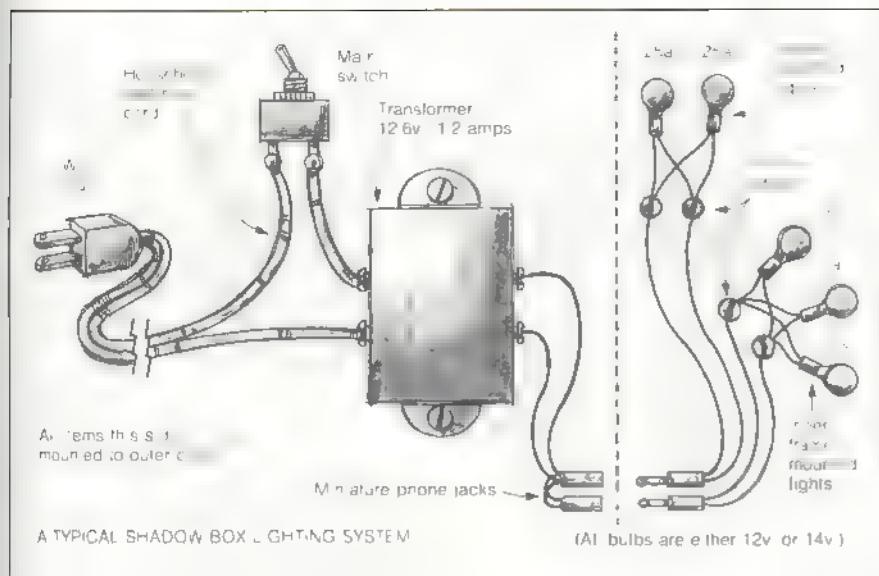
This selection of typical bulbs and sockets for lighting shadow boxes includes miniature bayonet-base lamps and automotive bayonet-base lamps at left and right, with grain-of-wheat and the ultra-small Pacific Fast Mail micro-miniature bulbs below them.

assemble the whole rig first, before installation.

The great bugaboo of every novice electrician is the short circuit. A short circuit is caused by the outgoing and ingoing lines from the power source coming into direct electrical contact. When this happens, the contact point becomes an accidental heat and light source; at low voltages it just smokes a bit, but at higher voltages, it can cause fire, sparks, and intense heat. Never touch the bare parts of both outgoing and ingoing wires at once; if you do, you become a short circuit, and at high voltages you can electrocute yourself. At lower voltages you will just get a mild shock, but it is still best to be careful.

The "Golden Rule" of electricity is this: NEVER TOUCH OR WORK ON THE SYSTEM WITHOUT UNPLUGGING IT. You can't get a shock if there is no current in the system, and without a power source, the wire is just wire. When the transformer is unplugged, there is no electricity anywhere in the system, and there is no way you can hurt yourself.

Start assembling the system with the main power cord. This should be long enough to reach from the transformer location through the hole in the back of the box, with about three feet to spare. This length requires an exten-



son cord to connect the shadow box to a wall socket, but you will probably need one anyway, and the short cord precludes tripping over it while carrying the box. Standard household lamp cord is fine, and a widely available quick-connect plug is easy to install. Strip about $\frac{1}{8}$ " of insulation from the other end of the cord, split the two conductor wires apart for about 8", and twist the wire strands to form more manageable wire ends.

The two leads are connected to the 115-volt side of the transformer. One lead will run directly to the transformer, and the other will run to the main power switch and then to the transformer. Twist the wires around the terminals, then, for a secure connection, solder them. Once you have experience soldering models (Chapter 7), electrical soldering is a snap. There's only one new wrinkle—acid flux is never used for electrical soldering.

Now move to the 12-volt side of the transformer. All wiring from here on is done with two-conductor model railroad or hi-fi speaker wire. Cut a piece long enough to reach from the transformer to one side of the box (with a bit to spare), strip about $\frac{1}{4}$ " of insulation from the ends, and connect the leads at one end to the two outside posts of the transformer (nothing is connected to the center post). Connect the other end of the wire to the female receptacle of a miniature phone jack. The jack affords a quick plug-in connection for the lighting system mounted on the scene. Since most lighting systems will also call for lights mounted on the inner frame, install two jacks. Connect them in parallel as shown in the drawing. The electrical installation for the outer case is now complete.

Now cut a piece of wire long enough to reach from the jack plug to the lights on the scene, and another piece to run

to the lights on the inner frame. Connect each of these to the jack plugs. The other end of each line should be connected to a pair of terminal posts installed in convenient locations on the scene and inner frame. Strip the wire ends, wrap them securely around the terminal posts, and tighten down the nuts. These terminals permit you to experiment with various styles and numbers of lights without having to dismantle the entire system.

Make wire leads for each of your light fixtures, connecting the leads permanently to the fixture and securing them with nuts to the terminal posts at the other end. Most light fixtures have some sort of mounting bracket, but you may have to devise some mounts yourself from wood or sheet brass.

What to do if it doesn't work. Your lighting system is now complete. Connect the jacks, plug in the main power cord, turn on the switch, and see if it works. If you have followed the steps carefully, everything should be fine and all the lamps should light. If they don't, immediately unplug the main power cord. Sniff for smoke and feel the wires and connections for heat. If the problem is not a short circuit, it means that the current flow is interrupted because (a) there is a loose connection somewhere or (b) you have goofed while connecting the wires, leaving a gap.

To locate the trouble spot, start at the main power cord and check each element of the system. Plug another appliance into the wall socket and extension cord to make sure that these are good. Make up a 12-volt test bulb as shown in the drawing, unplug the phone jacks, and clip the test light to the 12-volt terminals of the transformer. If it lights, the system up to that point is good, if it does not, you have narrowed the problem to the trans-

former, the plug, or the switch. Isolate each of these elements in turn until you find the culprit.

If the transformer, main power cord, and power switch are good, move further down the line, checking the circuit at each point until you locate the problem. Sometimes it is an improper connection, sometimes a faulty fixture. Remember, unplug the transformer from the wall each time you work on the system.

Optional features. A fuse is a piece of metal enclosed in a glass tube that forms part of the circuit; when too much current flows through it, the metal melts, breaking the circuit and preventing further damage. This safety option will protect the components of your lighting system from damage caused by a short circuit, and prevent your shadow box from becoming a fire hazard. Fuses and fuse brackets can be obtained at model railroad and miniature room shops and electronics supply stores such as Radio Shack. Choose a fuse to match the rating of your transformer. Simply connect the fuse in series in the line between the transformer and the jacks.

Larger lights are another option. To brightly illuminate a scene, especially a large one, you may want to use standard household 115-volt bulbs and fixtures. Electronics supply stores sell fluorescent tubes and fixtures as small as 6" long and these are very useful. Small incandescent bulbs (7, 15, and 25 watts) can be obtained, with fixtures, at hardware stores.

All 115-volt appliances should be wired into the lighting system between the switch and the transformer. In-line connections of this sort are easy; just twist the three cord ends together and secure them with a wire nut, available at your hardware store.

Establishing lighting effects. Now that we know the basics of building a lighting system, it's time to talk about what you want to do with it. The reason the phone jacks and terminal screws are worth the time spent installing them is that effective lighting is very



This 1/18 scale scene of the turret of the Monitor is approximately 14" across. I managed to illuminate it evenly by using a pair of 8" fluorescent tubes

much a matter of experimentation. You will have to vary the number of lights, their positions, and their brightness until you obtain the effect you want

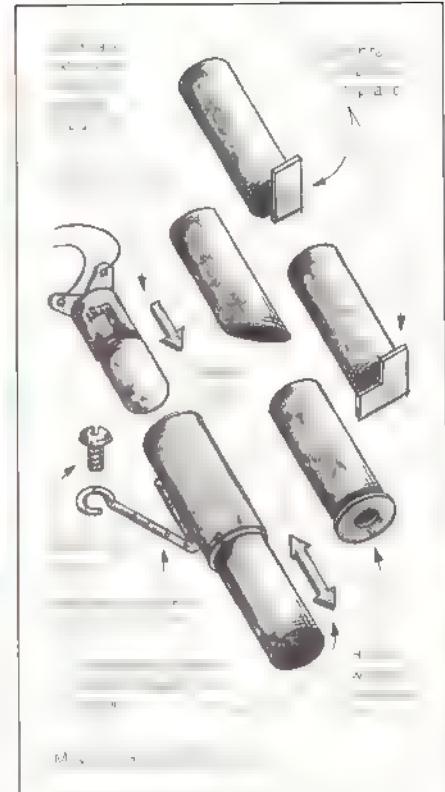
There are three basic lighting effects at your disposal, and they can be used alone or in combinations. These are single (pinpoint) source, diffuse, and focused. Light from a pinpoint source, such as the filament of a light bulb, casts sharp, distinct shadows, and several pinpoint sources can cast conflicting shadows. Diffuse light from a single wide source, such as a fluorescent tube, casts fuzzy, indistinct shadows. Focused light, such as the light from a spotlight, is directed only to a narrow, selected location. These are the lighting tools you have to work with.

First, decide how you want to handle the general illumination of your scene. General illumination can be provided with one bright pinpoint light, several smaller pinpoint, or a diffuse fluorescent light. If you are using a strong pinpoint light source, you may find the contrast between the highlights and shadows in the scene too great. This

can be cured in a number of ways. First try installing reflectors made of white cardboard or crumpled aluminum foil. Position these so they bounce light back up into the shadows. If this solution is not satisfactory, install small fill lights to illuminate the shadows. The fill lights should only be strong enough to bring out detail in the shadows without casting conflicting shadows of their own.

Use focused illumination to illuminate certain parts of your scene more than others. If a wide area is to be illuminated, try adding small pinpoint light sources in the right places. Another method of focusing light is to cut a paper mask that will fit in front of the light source and block light from certain areas.

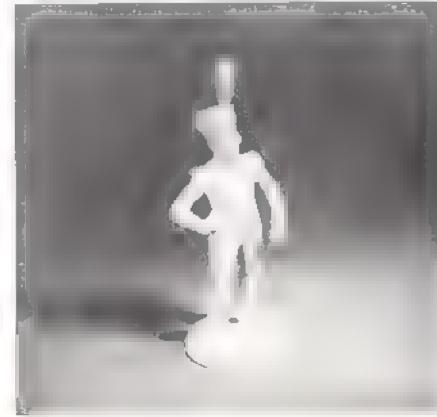
If a more restricted pool of light is called for, you will have to shield the light source in some way. The best method is to build miniature spotlights. These need be nothing more than brass tubes with a lamp inserted at one end. The inside of the tube should be bright (not blackened) so the



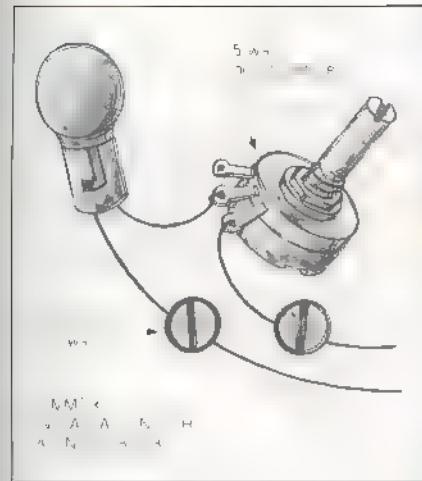
light pattern will be a spot instead of a ring. The spotlights can accommodate a telescoping extension tube to vary the area covered with light. These extensions can be made with various rims and shades to suit specific situations.

Spotlights can be used both as main lights and fill lights. Spotlight tubes are particularly handy for grain-of-wheat bulbs, because these bulbs have no other mounting devices.

Dimmers. There are special situations where you will want to increase or decrease the brightness of your lighting. A shadow box that looks good in a dark room, for example, may not have enough light for viewing in a bright room, and vice versa. Dimming all the lights in the system is quite simple, and can even be done as an afterthought. Hardware stores sell in-



Left to right, single source (pinpoint), diffuse, and focused (spotlight) lighting effects.



use dimmers which can be wired into your extension cord. This dimmer varies the current transmitted to all lights in the box, increasing or decreasing their brightness.

Eventually, you will want to dim lights individually to adjust them for just the right effect. This is something that must be planned into the lighting system during its construction. At an electronics store you can buy 5-watt potentiometers, commonly called "pots," which are little dimmers about $1\frac{1}{2}$ " in diameter. These can be wired into the system between the lamps and the terminals. A 5-watt pot can handle one or two .25-amp bulbs.

Don't automatically install a separate pot for each lamp in your system, because half of the bulbs usually have to be turned up to full brightness anyway. Instead, set up all your lights for full power, and then install pots on those that need to be toned down.

Colored lights. Occasionally you will want to use colored lights in your shadow box. The colors can range from overall deep blue tones for night scenes, to subtle warming colors for daylight. Unless the light source will actually be visible, stay away from

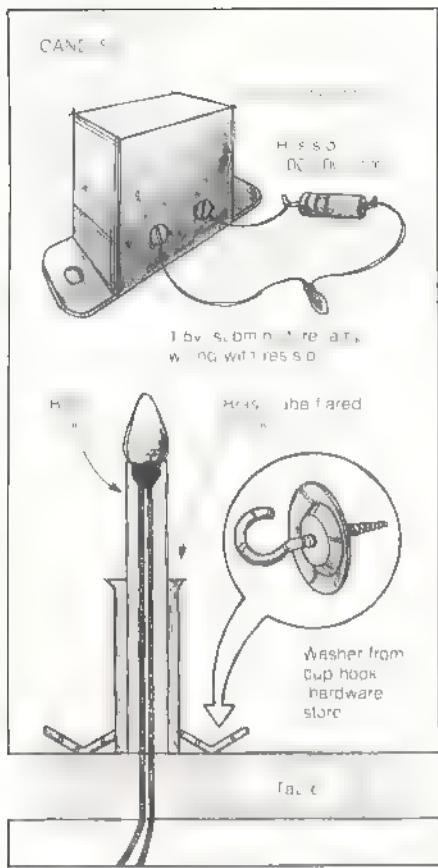


The eerie mood of "The Swamp Ogre" was achieved by installing a separate dimmer pot for each light in the scene. There is a masked spotlight on the ogre, another spot for the hero and heroine, a fill light for general illumination, a second small fill light behind the couple, and a bulb under the water, each with its own dimmer.



"The Death of Jim Bowie" employs several colored lights. The flash in the pan of the pistol is a PFM micro-miniature bulb inserted from behind, while the muzzle blast is a red grain-of-wheat bulb obscured with spun fiberglass "angel hair."

Candlelight creates unparalleled moods and dramatic effects. In this 1 18 scale scene of Napoleon at the tomb of Frederick the Great, the candles are PFM bulbs in a brass candelabrum. Wires run down the arm, body, and leg of the figure.



colored bulbs—their available range is limited, and the color may not be permanent. For hidden lights, all that is needed is a simple color filter held in front of the light.

Tinted gelatin or plastic filters, called gels, are used in the theater, television, and movies, and any place that sells theatrical lighting equipment should have them. The range of available colors is staggering, so ask for a sample book. When in doubt, buy the lighter of two colors. You can always use two or three thicknesses of a light tint to make a deeper color, but there is no way to lighten a single thickness that is too dark. Since a



This inexpensive sample book of colored theatrical gel swatches will provide sufficient material for dramatic lighting effects in several shadow box projects.

single 2 square gel is more than enough to last you a lifetime, an ideal source for miniature gels is the sample book itself, which contains sheets about 1" x 2". The theatrical supply house should be able to sell you a sample book, or you can send away for one.

If your bulb will be visible, achieving the right color is more difficult. You can buy red, green, and amber bulbs in various sizes from a model railroad shop, but the colors are quite harsh. Bulb coloring kits are made for scientific and automotive purposes, but you may have to do some hard looking to find them. Avoid using ordinary paint, since it will discolor from the heat.

Fireplaces and candles. Open flames in a fireplace can be simulated by hiding a grain-of-wheat bulb behind the logs. Surround the bulb with crumpled orange, yellow, and red gel filters for flames, and add crumpled aluminum foil for coals.

Candles are more awkward. Pacific Fast Mail offers excellent subminiature bulbs for model railroad use that give an excellent candle effect, but they are expensive and temperamental. The bulbs are rated at 1.5 volts and run well off a standard flashlight battery, but batteries always die out at just the wrong time. If you want to incorporate 1.5-volt subminiature bulbs into your 12-volt system, you will have to install resistors in line with the bulbs. A resistor is an electrical "sponge" that soaks off enough current to drop the voltage to the desired level. Resistors are available in various ohm ratings at any electronics store. My experience is that a 1/2-watt, 100- to 200-ohm resistor is about right for use with PFM bulbs, but you will have to test to be sure, so buy an assortment of resistors.

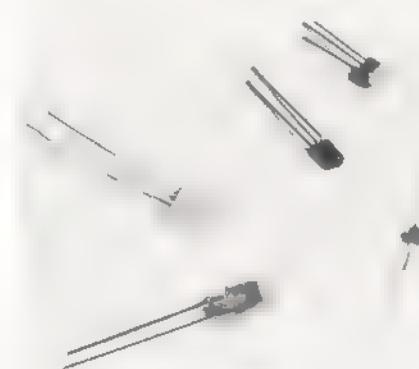
Hook up the bulb to the transformer with the resistor connected in series with the bulb. Start testing using a resistor with a high ohm rating, and gradually work your way down. At first nothing will happen because the resistor is soaking off too much current, but as you reduce the ohm value, the bulb will start to glow. When you have an acceptable glow, stop; these bulbs burn out very suddenly. When you have found the proper resistor, install it permanently in the system. You can also add a potentiometer to the line if you want to vary the brightness of the candle.

Construction of a simple candlestick and candle is shown in the drawing. Brass is the best material to use because of the heat generated by the bulb. Make sure that when you design your scene you devise some way to run the wires out of sight. To keep the bulb in the proper position, tack it lightly in place with white glue. The glue can

be dissolved with water to replace the bulb.

Other lighting tricks. As you become more deeply involved in lighting shadow boxes, the electronic aspects of the projects take on a fascination and challenge of their own. New developments in lighting are always potentially useful to you, and it is worth keeping up with them. A fairly recent development, for example, is the light-emitting diode (LED), which was originally developed for digital readouts in calculators and monitor lights for stereos. An LED is best described as a colored bit of plastic which lights up when current is applied to it. Since there is no filament to burn out, LED's last practically forever, which makes permanent installation possible. While they don't throw much light, they do glow nicely and are excellent as miniature lights in a scene. Modelers have recently discovered that LED's are perfect for navigation and instrument lights on model aircraft, and the effect when the navigation light is connected to a flasher unit is most impressive. LED's can be permanently built into a model at the time of construction, without having to worry about replacement, and, in series with a resistor, they can be operated by anything from penlight batteries to a standard 12-volt lighting system.

Model railroaders are frequent beneficiaries of new developments in miniature lighting techniques, and the electrical aspects of miniature rooms are only beginning to be explored. One miniature room innovation that has already come about is the use of flat metal tape instead of wire. The tape can be run along the surface of a wall to a light fixture, and is so thin that it can be hidden by wallpaper or even a couple of thick coats of paint.



Although LED's do not give off a great deal of light, they are ideal for instrument panels and navigational marker lights on aircraft models. Their lack of heat gives them a decided advantage over bulbs.



13 Step-by-step

The meeting of the Admiralty Board

During the 300 years that Britannia ruled the waves, the nerve center of British naval power was in the Board Room of the Admiralty in London. It was the Admiralty Board, presided over by the First Sea Lord, that made the strategic decisions and gradually amassed the empire on which the sun never set. The Admiralty Board was also responsible for approving the design and authorizing construction of all ships built for the Royal Navy. Since the time of Samuel Pepys in the reign of Charles II, it was mandatory for the designer to submit a model of the proposed vessel along with his plans. These Admiralty models were exquisitely crafted, and are the most sought-after antique ship models.

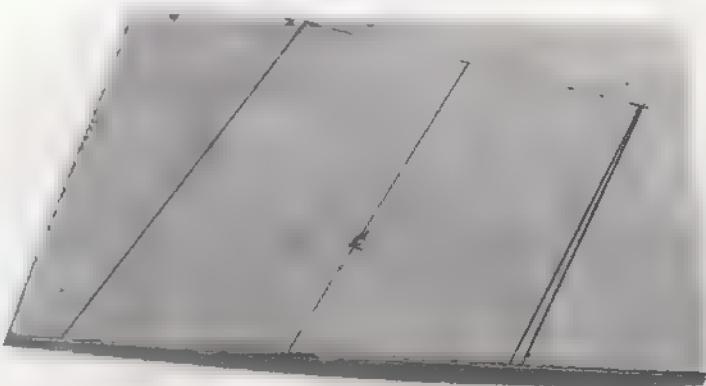
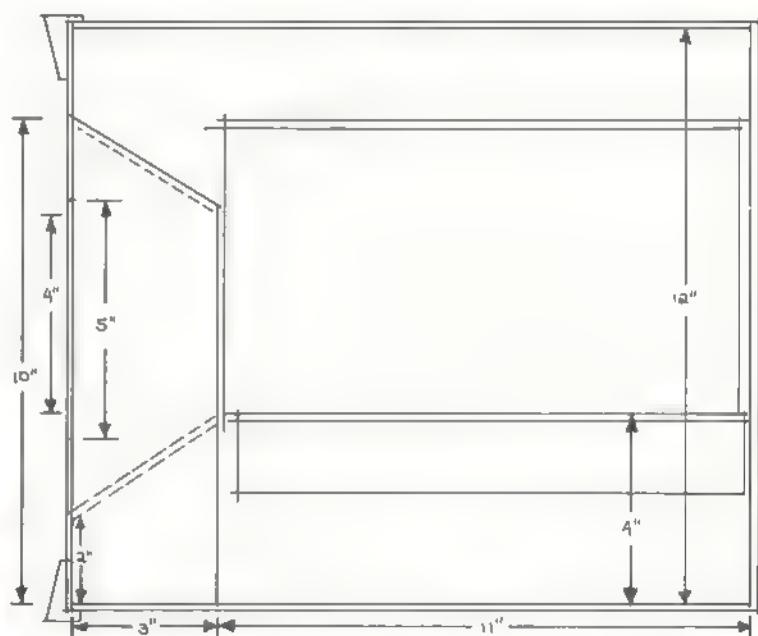
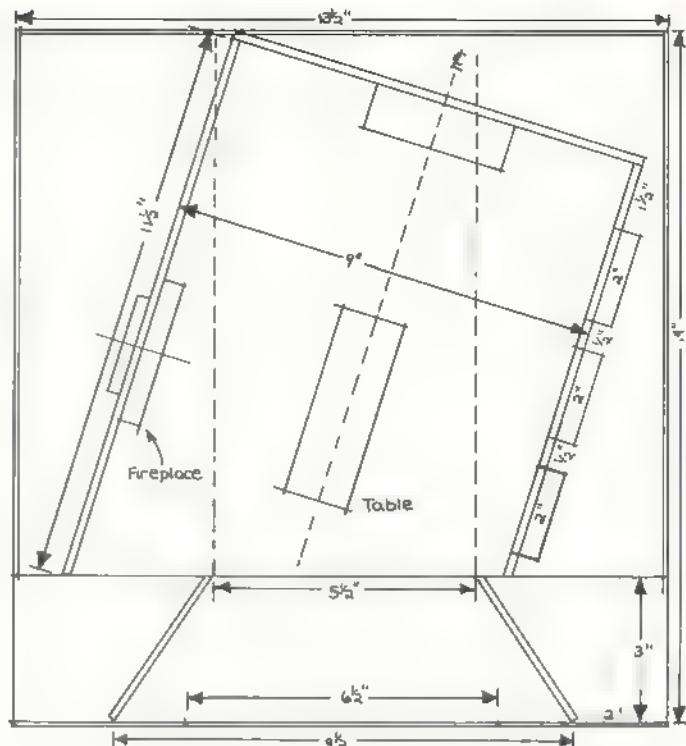
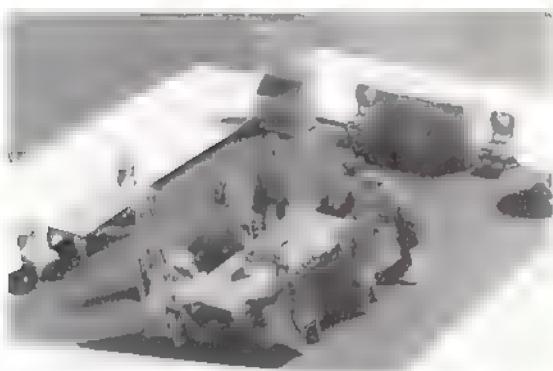
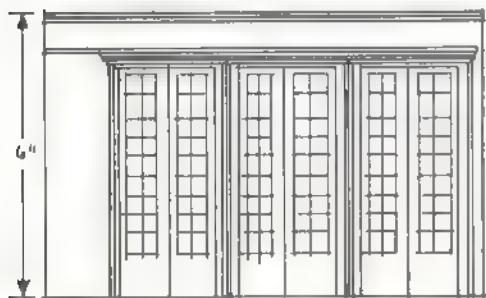
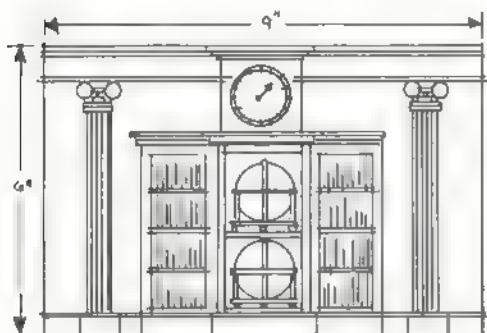
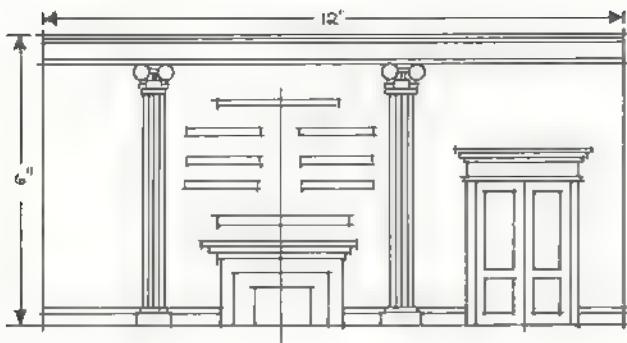
In the scene, the Admiralty Board is

meeting to discuss the merits of a new 104-gun three-decker, a first-rate ship of the line. It might even be HMS *Victory*, whose keel was laid in 1765. The First Sea Lord is at the far end of the table, deciding whether the occasion calls for a little port, while the other members, with varying degrees of interest, examine the latest proposed addition to His Majesty's fleet.

Although the Admiralty Board has long been on my list of desirable subjects, it was chosen for this book because it could be built using furniture and figures that are available in kit form. Phoenix Model Developments of England has produced several series of diorama-oriented 54mm figures, and their eighteenth-century Tavern group is one of their best. The char-

acter of the figures is marvelous, and the poses are ideally suited to a subject like the Admiralty Board. Sufficient furniture is also available to fill out the scene, leaving only the walls and details to be constructed.

The complexity of the Admiralty Board scene is about average for a shadow box diorama. The modeling challenges in this project include the rigged Admiralty model on the table, the bookcases full of books along the rear wall of the room, and the two large globes housed in the center bay between the bookcases. Although the Admiralty Board Room still exists, it has been redecorated several times since the scene I wanted to re-create took place, so I used an eighteenth-century print as reference.

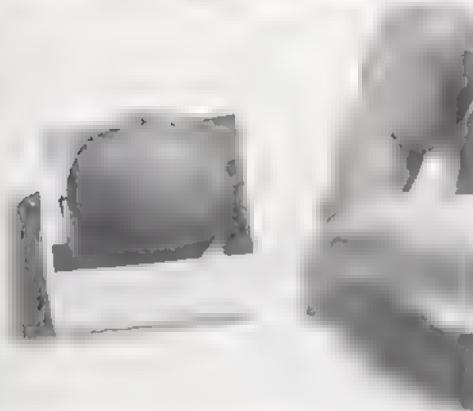
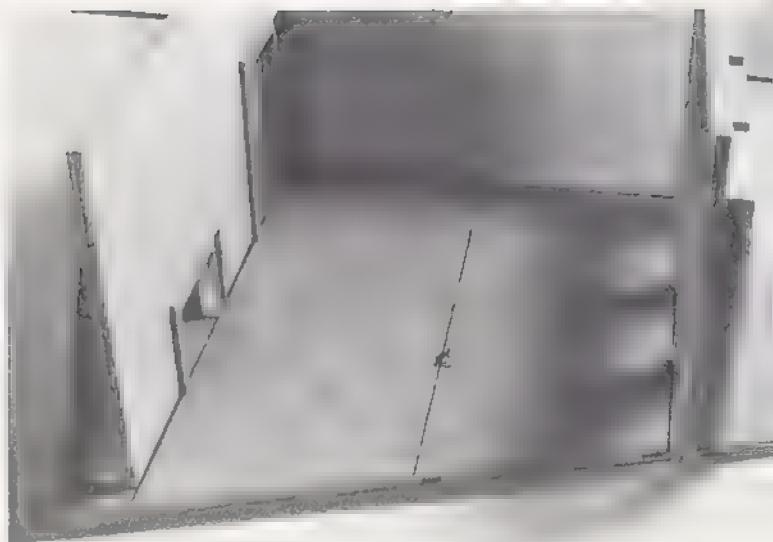


The first step, as always, is planning. Here the figures and furniture are laid out to establish the floor plan. Some of the furniture will be relocated in the course of construction, but the overall effect is very close to the finished version. Having the viewer look at the table from the end means that figures can be placed on both sides, but it also means that they must be carefully positioned if all of them are to be seen through the viewing window.

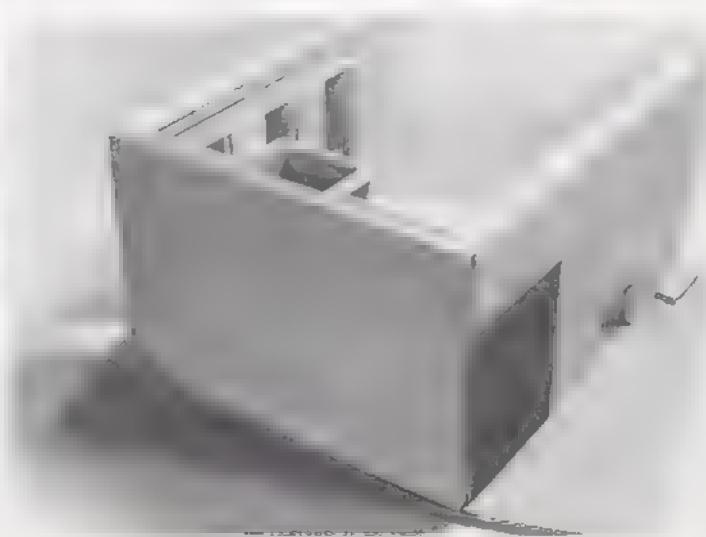
The outline of the walls is traced onto the base. There is still some doubt as to the exact angle of the walls, a problem that will be dealt with later.



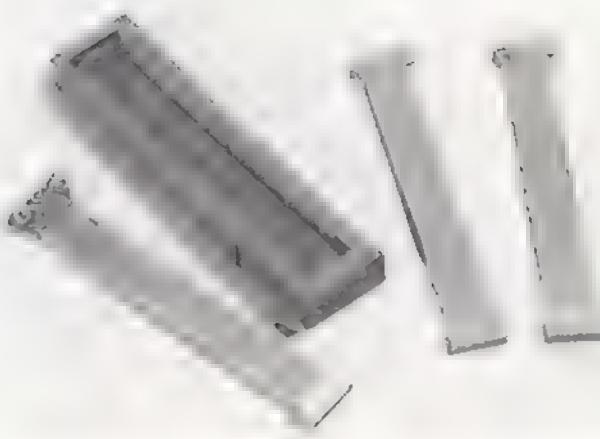
The walls were cut from $\frac{1}{4}$ " model aircraft plywood and brushed with several coats of artist's gesso. The location of the large bookcase has been marked on the back wall. As soon as the walls were cut, they were mounted on the base to check the fit. Notice that one wall is a little short for the base while the other is a little long. This is due to a last-minute adjustment in the angle of the right wall. The discrepancy will not show once the scene is in the box.



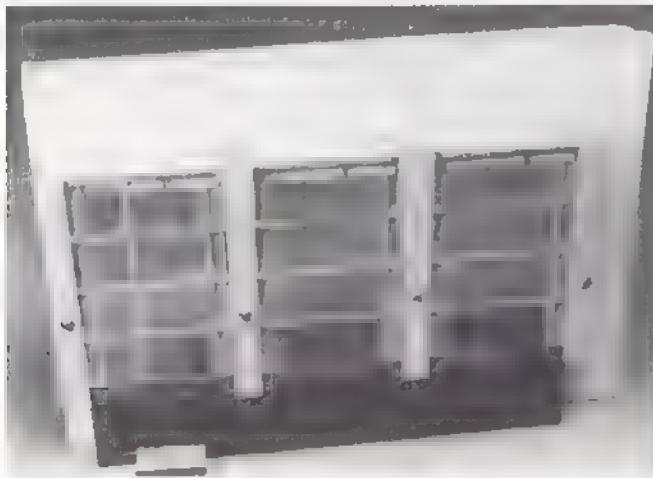
I expected the two large globes, one terrestrial, one celestial, to be a challenge, but they came off without a hitch. The globes themselves are cheap rubber balls that I bought at the dime store. The molding seam makes a nice equator. The frame consists of HO porch pillars and circular parts cut from sheet styrene with the aid of a pair of dividers. In order to draw the latitude and longitude lines on the globes, I built a simple fixture. The rubber balls were mounted on pins that passed through holes in the box. By sliding a pencil across the side of the box, I made longitude lines, and by holding the pencil stationary and rotating the globe, I made perfect latitude lines.



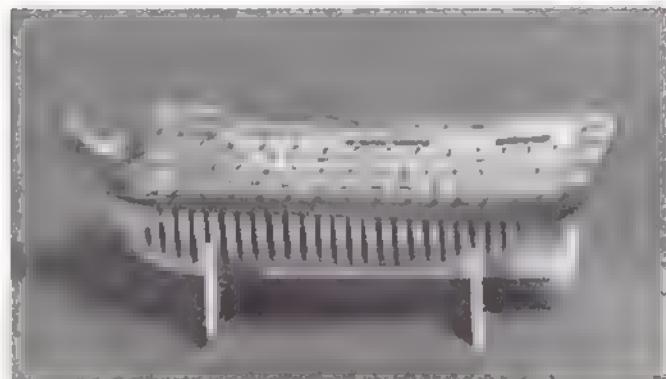
Here, the walls are almost completed. The pilasters were glued in place first, and the moldings fitted around them. The fancy-looking cove moldings are nothing more than layered stripwood. The double door is heavy illustration board paneled with stripwood. The fireplace is lined with illustration board, and the bookcase is basswood. A disc of styrene was added to the bookcase for the wind direction indicator. The floor is scribed basswood sheet, glued down with contact cement to avoid warping. The back view shows the screws which hold the walls to each other and the base.



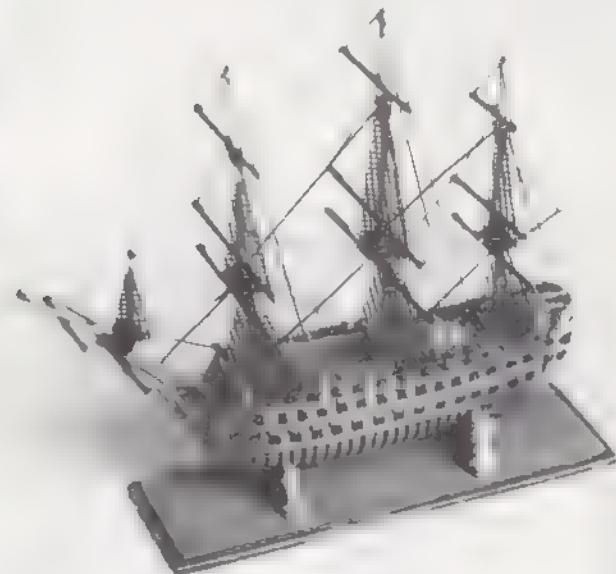
The Corinthian pilasters add a classical eighteenth-century touch, so it was worth the effort to cast them. The pattern was a basswood backing with strips of two thicknesses glued to it to form the grooves. The capital was then sculpted from epoxy putty. From left to right, the pattern, the mold, and two castings. Linear shrinkage, which is unavoidable, means that the cast columns are about $1/16$ " shorter than the pattern, so I had to make allowances for this in the pattern.



All window framing on the right wall is stripwood. If you look closely, you can see that the window moldings are only detailed on the side that can be seen from the viewing window. The glass is a single sheet of clear styrene held in place with wood battens screwed to the wall.



The ship model is the center of attention in the scene. Fortunately, an appropriate ship was available, part of *Vallant Miniatures*' line of wargame models. All that was needed was to add the portion below the waterline. It was traditional for Admiralty models to have the planking stripped away below the waterline to show the inner structure of ribs. I modeled this by gluing together wide and narrow pieces of sheet styrene sandwich-style, forming a solid block as long as the ship. This block was cut and ground down with a Dremel tool, and final shaping was done with sandpaper and a sanding block.



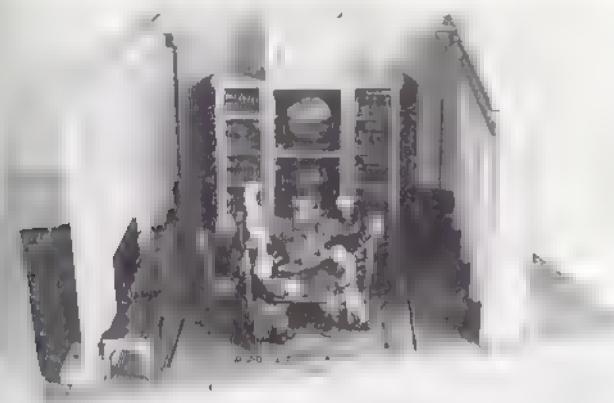
I rigged my model, but Admiralty models were also made unrigged, with stump masts. The rigging was done with strands of fine electrical wire, cut to length and glued in place with white glue. The masts are brass wire, held together with super glue. The ratlines are model railroad expanded aluminum screening, and the base and supports are styrene, with golden dolphins made from epoxy putty.



Each shelf of books on the back wall is an identical resin casting, painted to look different. The strange device over the bookcase is a wind gauge, which was attached to a weather vane on the roof of the building and which told their lordships whether the wind was right for the fleet to sail. Its hand is a watch hand scavenged from a watch repair shop.



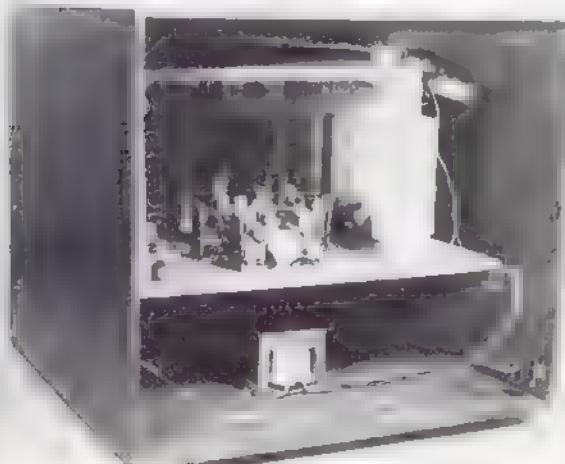
Details on the left wall include map cases made from Plastruct tubing and brass wire rods. Note the small hole at the back of the fireplace for a grain-of-wheat bulb for the fire.



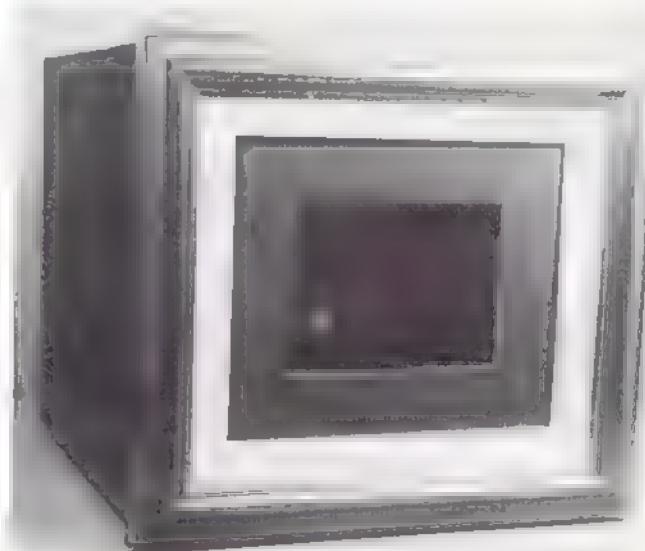
The assembled scene. The wind gauge and ceiling have not been installed, but all other elements are in place. Although the figures were painted all the way around, the greatest care was taken only with the side that would be seen.



The ceiling is held in place by four screws. A single GE 1003 bulb was later substituted for the two GE 97 automotive lamps shown here because they cast conflicting shadows. The lead running over the top is for the fireplace light, which is masked with crumpled red cellophane. Later, the wires were taped down so they would not be seen through the windows. A filler light was installed on the top of the inner frame in addition to the lighting shown here.



Above, the scene has been installed in the outer case. Note the transformer, on-off switch, and shelf supports. At right, the completed shadow box after the frame and inner frame have been installed on the front of the case looks like this. The brass tie plate is not yet attached to the mat.





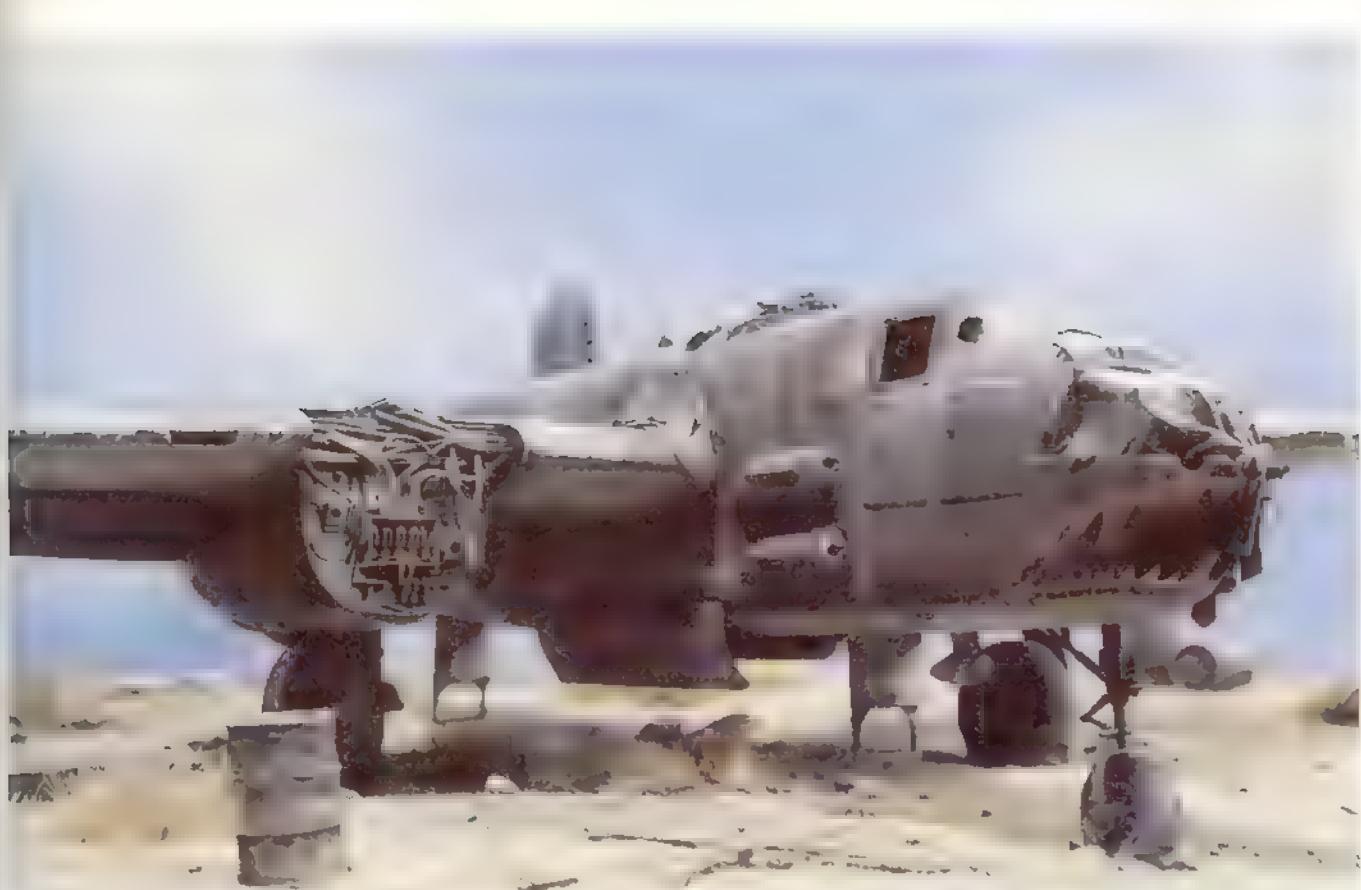
The plans scattered on the table and floor were lightly drawn in pencil on paper that had been dipped in weak coffee. The

servant call cords overhead are twisted solder wire with Historex trumpet tassels at the ends.



The elaborate carpet is a trimmed-down miniature room item. The wine glass on the servant's tray consists of a bowl made by carefully cutting off a grain-of-wheat bulb, and a stem turned

from a small piece of plexiglass rod. The wine itself is a liquid stained glass product sold for use in the miniature rooms and dollhouse crafts hobbies.



To make your pictures appear as if they were taken by a real photographer standing on the ground, place the center of the camera lens at scale eye level. Placing the lens even lower

will make the model appear larger and more dramatic. The dramatic effect of this lonely derelict B-25 was also enhanced by using a 28mm wide-angle lens in place of the normal lens.

14

Photographing your dioramas

Taking pictures of your dioramas adds a new and exciting dimension to your hobby. Aside from keeping a record of your work—important if you part with your dioramas—photography allows you to take a fresh look at your scenes. Photography also allows you to achieve some special effects not possible in a static display, such as night scenes, dramatic lighting, and the smoke and dust of battle. In some cases you'll like the photographs better than the dioramas themselves, and may even find yourself building scenes with particular photographs in mind.

The purpose of this brief chapter is to acquaint you with the bare essentials of model photography, and to outline the minimum tools required to take decent pictures. With the equipment described here—and a little practice—you should be able to take pictures suitable for publication.

Equipment. Model photography is a specialized field that requires a certain amount of special equipment, but not nearly as much as you might expect. These are the minimum essentials:

- **Camera.** If you don't already have a suitable camera, this will be your biggest investment. When selecting a camera, consider its usefulness for family and other types of photographs, as well as its model photography use. A single lens reflex (SLR), the most common type of 35mm camera sold today, is practically a must. This type allows through-the-lens viewing, which means that what you see through the viewfinder is exactly what you'll get on film. Most SLR's come with a built-in, through-the-lens light meter. This is a desirable feature, because it frees you from having to measure the light and compute the correct exposure. The 50mm lens that

comes with the camera is fine, although you will have to buy a set of inexpensive close-up lenses that screw onto the front to allow it to focus at close distances. A tripod is also required, because you will be shooting at slow shutter speeds and must keep the camera steady. Screw-type camera elevation on the tripod is very handy. A cable release, which allows you to click the shutter without touching the camera, is also helpful.

- **Film.** The films I find most dependable are Kodak High Speed Ektachrome (Tungsten) for color slides and Plus-X for black-and-white. Color is more expensive and less forgiving of mistakes, so it is much cheaper to learn with black-and-white film.

- **Lights.** Nothing fancy here. Camera shops sell inexpensive photoflood bulbs that are good enough for what we are doing. These bulbs look like

The dust in this battle scene is cigarette smoke. Note how the low camera angle again lends a dramatic effect.



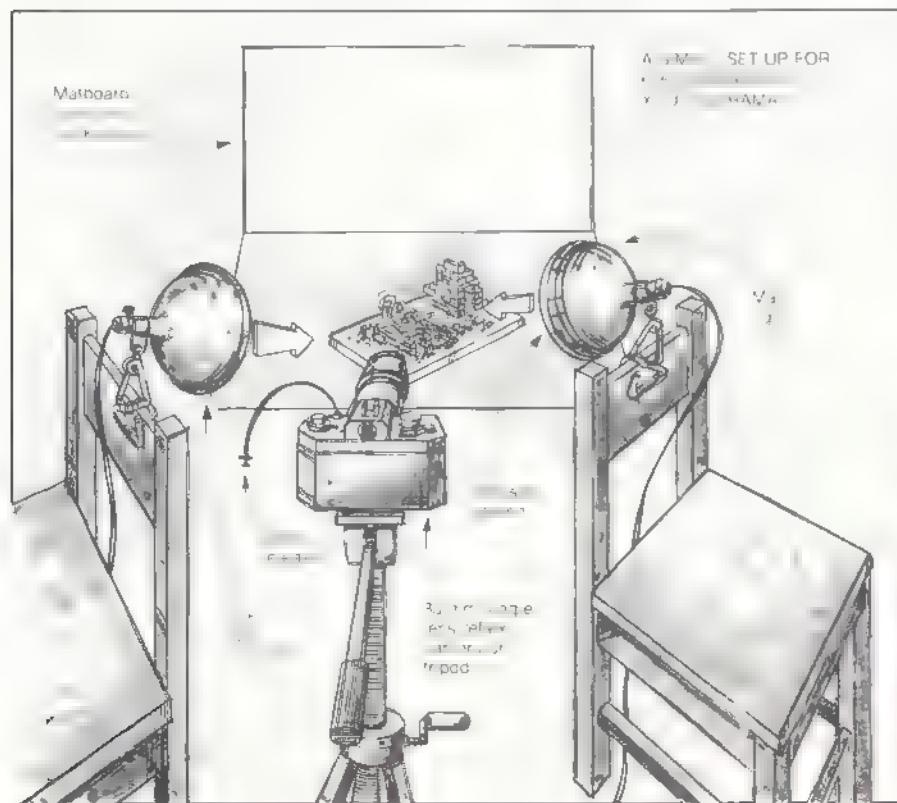
ordinary light bulbs and fit standard sockets. You will need two sizes, 500 watt and 250 watt. Make sure that the bulbs you buy are color balanced at 3200 degrees K to match your film.

Ordinary clamp-on fixtures are fine, although you may want to invest in light stands later on. You will also want a 10" reflector for each light, and a plastic or fiberglass diffusion

screen to cut down the harshness of the shadows.

● **Background.** You can use your imagination here, but a good way to start is to purchase two pieces of light blue mat board, one to go under the model and one to go behind it.

● **Optional equipment.** As you learn more about photography, you may want to consider adding specialized gear to your equipment. A macro lens is especially designed for close-up photography, providing closer focusing distances and sharper pictures without the aid of close-up lenses. A telephoto lens will allow you to photograph from



Kamibach Books Art Schmid

This typical 35mm SLR is easy to use, and because it is a common type of camera, a wide range of accessories is available. The screw-on closeup lens shown here is one of the most useful extras.



These photos show the relationship of lens opening to depth of field. The setup and focus in both was identical, but the



photo on the left was shot at an aperture (lens opening) of f2.8, while the one on the right was shot at f16.

farther back, and to zero in on details at the back of your scene. A strobe flash unit provides more light than photo-flood lamps, and generates less heat.

Setting up. Allow plenty of room for photography. You'll be surprised at how much room it takes to photograph even a single figure, and you don't want to trip over anything. The drawing shows a typical setup. In the beginning, position your main light (the 500 watt) above and to one side, slightly toward the front of the model, and about 3' away from it. Place the second light (the 250 watt), your fill, level with the model and on the opposite side from the main, twice as far away. This light will help fill shadows, but watch that it is not bright enough to cast conflicting shadows of its own. If it does, move it farther away. Keep the lights on only when you are looking through the viewfinder or snapping the shutter, because they give off a lot of heat, enough to warp and melt plastic models.

From here on, lighting is strictly a matter of experience and experimentation. Try something, and if it doesn't work, try something else.

Exposures. The primary problem in miniature photography is achieving adequate depth of field (depth of focus). The closer you move your camera to an object, the narrower the camera's range of focus becomes. In this respect the camera is the same as your eye; hold your finger 12" in front of your face, and you cannot focus on both the finger and the background at the same time. The controls on the camera allow you to select a center of focus, but things will start to go fuzzy behind and in front of this center. When you get the camera really close, say 3" or 4" from the model, the maximum area in sharp focus will be little more than 2"



To add smoke effects, blow smoke at the model just before tripping the camera shutter. Because the smoke is hard to control, take several shots at each angle so you can pick the best one.

deep. On a 54mm figure with an out-thrust musket, this area of sharp focus barely covers the figure and the length of the bayonet.

We can't overcome depth of field limitations completely, but we can learn to live with them. The critical factor in achieving satisfactory depth of field is this: *The smaller the lens opening (f stop) the greater the depth of field.* Always shoot with the lens set at minimum aperture. On most cameras this will be f16 or f22, although some macro lenses will stop down to f64. This means varying only the shutter speed to control exposures. Set your aperture, turn on your lights, read the meter in the viewfinder, and adjust the shutter speed for proper exposure.

With the lighting I've described, you will usually shoot at shutter speeds between $1/15$ and $1/2$ second. When focusing, bear in mind that the depth of field extends $1/3$ in front of the focusing point and $2/3$ in back of it, so focus

slightly forward of the center of your subject. Some cameras have a depth of field preview button that allows you to check focus. An out-of-focus foreground is more distracting than an out-of-focus background, so take care of the foreground first.

Now you are ready to click the shutter. Bracket your exposures by shooting one picture at the exposure indicated by the meter, then at one f stop above it, and one stop below. Although the camera meter is usually accurate, it can be fooled, and bracketing exposures provides some insurance. Professional photographers bracket their exposures—one reason they always come back with the picture.

Special effects.

● Night scenes. These are easily achieved by underexposing the film, possibly using a blue filter as well. You will have to experiment to get just the right degree of night effect.

● Bright desert sun. This is the opposite of a night scene, so overexpose the film one stop.

● Grainy "combat" appearance. The grainy appearance of most combat footage is a result of the cameramen using high-speed film, which has coarse grain. To duplicate this effect, use a high-speed film such as Tri-X for black-and-white or Ektachrome 400 for color. The grain effect may not be noticeable until you make enlargements.

● Smoke and dust. These are created by blowing cigar or cigarette smoke through a tube onto the scene. Experiment with different angles and pressures. If you blow hard, the effect is hazy, if you blow very softly, the smoke will float gently across the scene, hugging the hollows like ground fog. Shoot each pose at least three times, because smoke is an accidental effect—you may find only one of the shots is just the effect you want.

Dedication

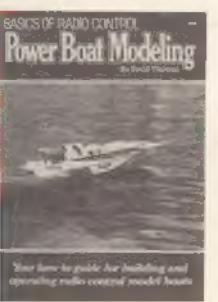
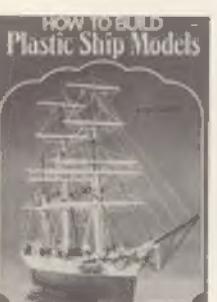
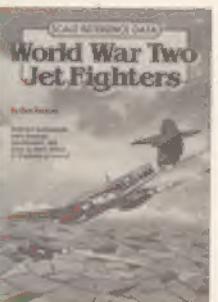
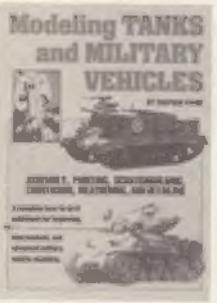
For Archer Jackson.

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